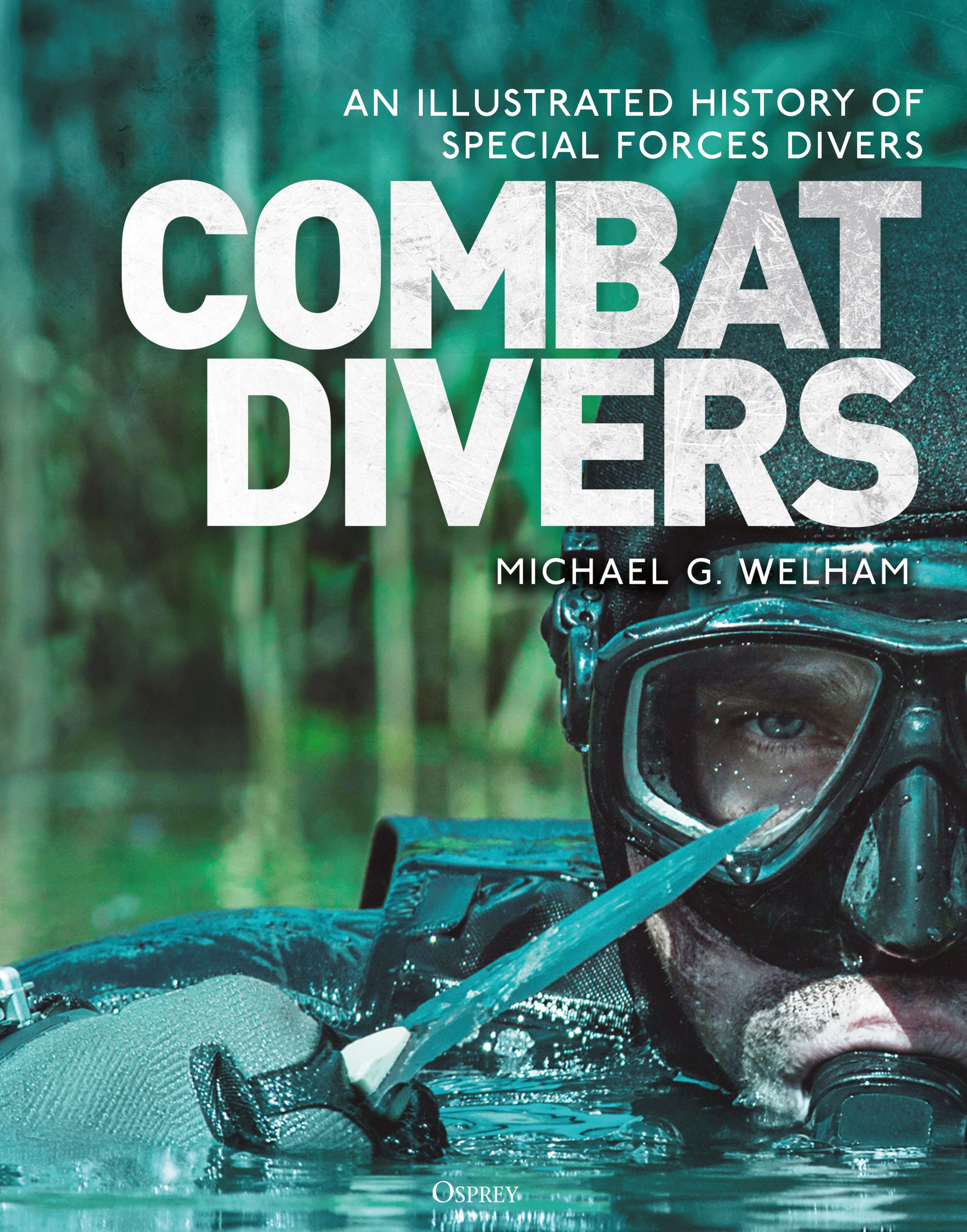


AN ILLUSTRATED HISTORY OF SPECIAL FORCES DIVERS

COMBAT DIVERS

MICHAEL G. WELHAM

OSPREY

COMBAT DIVERS

OSPREY
PUBLISHING

COMBAT DIVERS

AN ILLUSTRATED HISTORY OF SPECIAL FORCES DIVERS

MICHAEL G. WELHAM

OSPREY PUBLISHING

Bloomsbury Publishing Plc
Kemp House, Chawley Park, Cumnor Hill, Oxford
OX2 9PH, UK
29 Earlsfort Terrace, Dublin 2, Ireland
1385 Broadway, 5th Floor, New York, NY 10018, USA
E-mail: info@ospreypublishing.com
www.ospreypublishing.com

OSPREY is a trademark of Osprey Publishing Ltd

First published in Great Britain in 2023

This electronic edition published in 2023 by Bloomsbury Publishing Plc

© Michael G. Welham, 2023

Michael G. Welham has asserted his right under the Copyright, Designs and Patents Act, 1988, to be identified as Author of this work.

For legal purposes the Acknowledgements on pp. 7–8 constitute an extension of this copyright page.

All rights reserved. No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording, or any information storage or retrieval system, without prior permission in writing from the publishers.

A catalogue record for this book is available from the British Library.

ISBN: HB 978 1 4728 5600 5;
eBook 978 1 4728 5603 6;
ePDF 978 1 4728 5602 9;
XML 978 1 4728 5601 2

Cover, page design and layout by Stewart Larking
Main cover image: iStock
Title page image: iStock
Artwork on pp. 30–31 by Howard Gerrard © Osprey Publishing, previously published in RAID 8: *The Cockleshell Raid* by Ken Ford (Osprey Publishing, 2010)
Index by Alan Rutter

Osprey Publishing supports the Woodland Trust, the UK's leading woodland conservation charity.

To find out more about our authors and books visit www.ospreypublishing.com. Here you will find our full range of publications, as well as exclusive online content, details of forthcoming events and the option to sign up for our newsletters.

CONTENTS

Acknowledgements		7
Acronyms and Abbreviations		9
Introduction		10
CHAPTER 1	Frogmen: The Beginning	13
CHAPTER 2	Experimental Diving	24
CHAPTER 3	Combined Operations Pilotage Parties	38
CHAPTER 4	Far East Operations	44
CHAPTER 5	Scandinavia Targeted	54
CHAPTER 6	Special Forces Diver Units	78
CHAPTER 7	Female Military Divers	148
CHAPTER 8	Special Forces Diver Selection and Training	162
CHAPTER 9	Combat Diver Infiltration Options	184
CHAPTER 10	Anti-Terrorism and Piracy	199
CHAPTER 11	Mine and Bomb Disposal	208
CHAPTER 12	Swimmer Delivery Vehicles and Dry Deck Shelters	215
CHAPTER 13	Mini-Submarines	233

CHAPTER 14 Combat Divers' Equipment 242
CHAPTER 15 Weapons Underwater 251
CHAPTER 16 Marine Mammals at War 258
CHAPTER 17 Remote and Autonomous Underwater Vehicles 265
CHAPTER 18 Undersea Spying and Sabotage 273
CHAPTER 19 The Future 286
Further Reading and Bibliography 293
About the Author 296
Index 297

ACKNOWLEDGEMENTS

Special thanks to Joe Welham, my developmental editor. Thanks to Andrew Lownie, my literary agent, for his inspiration for the project, and to Kate Moore, Commissioning Editor at Osprey Publishing, and Gemma Gardner, Senior Desk Editor at Osprey.

In addition to thanking those detailed below, I wish to thank all those not mentioned who have assisted with photographs and/or information.

Individuals:

LCDR M. Shutka NAVINFO EAST Director (USA) Author Support
LCDR M. Stroup USN USSOCOM NSW (USA) Media Officer
Luitenant-Kolonel Eric Lieftink, Netherlands Maritime Special Operations Force (NLMARSOF)
Kaptmarins R.H. Philippo, Head of the Frogman Instruction Course
Brett Phaneuf – MSubs
Philip Hilbert – MST Group
Stephen Marshal – Cobham
Mike Aitken – Shark Marine Technologies
Lee Ebsworth – SubSea Craft
Paul Haynes – JFD
LCDR Ramil Sahol PN – Philippines Naval Special Operations Command.
Nielsen, Sune Wadskjær – Denmark

Defence departments:

US Navy Department of Defense
US Navy Special Warfare Command
US Navy Marine Mammal research unit – Point Mugu in California, USA
US Navy – The Reconnaissance and Interdiction Division
US Army – Special Forces
US Marines
Australian Department of Defence
Danish Ministry of Defence

German Marinekommando – Presse- und Informationszentrum
Swedish Armed Forces
Philippines Naval Special Operations Command

Defence departments (photographs):

DVIDS – US Navy Department of Defense
Australian Department of Defence
US Defense Information Distribution Service
Denmark Armed Forces
Netherlands Maritime Special Operations Force (NLMARSOF)
German Marinekommando – Presse- und Informationszentrum
Russian Federation Ministry of Defence

ACRONYMS AND ABBREVIATIONS

ACCROV	Advanced Concept Combat Remote Operated Vehicle
ASW	Anti-Submarine Warfare
AUV	Autonomous Underwater Vehicle
CD	Clearance Diving/Diver
CDQC	Combat Diver Qualification Course
COPP	Combined Operations Pilotage Parties
CRAB	Crawling Remotely Operated Amphibious Breacher
DDS	Dry Deck Shelter
DPD	Diver Propulsion Device
DSEA	Davis Submerged Escape Apparatus
EOD	Explosive Ordnance Disposal
ERC	Expeditionary Reconnaissance and Clearance
FDU	Fleet Diving Units
HAHO	High Altitude High Opening
HALO	High Altitude Low Opening
IDF	Israeli Defence Force
IED	Improvised Explosive Devices
IEDD	Improvised Explosive Device Disposal
JFD	James Fisher Defence
LCU	Landing Craft Utility
LCVP	Landing Craft Vehicle Personnel
MARSOF	Maritime Special Operations Force
MCM	Mine Counter Measures
NAVSOCOM	Naval Special Operations Command
RAN	Royal Australian Navy
RIB	Rigid Inflatable Boats
RMBPD	Royal Marine Boom Patrol Detachment
ROV	Remote Operated Vehicle
SASR	Special Air Service Regiment
SBS	Special Boat Squadron
SCUBA	Self-Contained Underwater Breathing Apparatus
SDV	Swimmer Delivery Vehicle
SEAL	Sea-Air-Land
SF	Special Forces
SFG	Special Forces Group
SOF	Special Operations Forces
SWCS	Shallow Water Combat Submersibles
TDV	Tactical Diving Vehicle
UDT	Underwater Demolitions Teams
UKSF	United Kingdom Special Forces
UUV	Unmanned Underwater Vehicles

INTRODUCTION

Many jobs can be classed as dangerous, but being a military special forces diver is certainly close to the top of the list, and yet there is no shortage of volunteers wanting to become one – even though only a tiny minority successfully pass selection. It is dangerous for the same reasons as any special forces role, but it also involves operating underwater, often in very testing environments where there is reliance on specialist equipment to provide life support. Special forces operatives routinely put their necks on the line in training and on operations, but I do not intend to try to answer the question of why they do it, because in the end it is a personal decision – it's the job, it's what they do. Special forces and diver training is lengthy and ongoing, an evolving learning process where missions are planned with the 'what ifs' factored in, and fallback options added. The risks are calculated, but it is underwater where things become truly unpredictable.

The role and operations of divers and covert swimmers during World War II have been recounted in detail in countless books and articles, and although the role has generally remained the same, the methods and equipment have been enhanced through technical developments and operational capability. Today, combat diver operations are shrouded in great secrecy, and even within the special forces infrastructure they generally retain an air of mystery. Whenever there is military action in the modern world the media are generally not far behind, and if special forces are involved the inquisitiveness multiplies. On land the special forces are exposed to scrutiny, but below the water their world remains out of bounds, and following any destructive activity the perpetrators are long gone.

Most people probably have some understanding of the role undertaken by special forces through books written by former operatives, movies, TV programmes, and the media, but for those who use the underwater domain as a method of infiltration, or for carrying out covert operations, it is imperative that their world remains unknown and unseen. The success of future operations, both in limited wars, and in any major conflict, could depend upon the secrecy enforced today.

Nations rely on water for their very existence by way of trade and transport. Tankers, bulk carriers and cargo ships of many forms and sizes ply the oceans, maintaining vital trade. To halt those movements in times of conflict could cripple a nation and force it into submission; therefore, countries must keep

their sea lanes open, and their harbours, docks, ports and rivers – which are prime targets – safe from underwater attack.

For the combat diver in these waters it is a world that leaves them fighting not only an enemy's aggressive defences, but also the tides, currents, weather, marine life, cold, heat and – equally challenging – equipment failure. These highly trained combat divers, operating in small groups, may drop by parachute, deploy from hovering helicopters, launch from submerged submarines or be carried to the target by a great variety of surface craft. But once in the water they are alone, with no back-up.

During World War II, diving was transformed with the introduction of more flexible rubber drysuits and self-contained breathing apparatus, which replaced the twill dive suits of the standard diver, who had been tethered to a hose from the surface carrying air down to the heavy helmet that connected to the suit. Now with fins on his feet instead of weighted boots, he became free swimming. Because of their appearance they were termed 'frogmen', a name that, while synonymous with those times, is still favoured by some military diver units today, including both the Dutch and Danish Marines special forces. The term 'combat diver' has been widely adopted, but in some cases titles such as 'clearance diver' are used to identify a primary role of dealing with mines and bombs, while the British Army have adopted Explosive Ordnance Disposal/ Engineer Diver. Adding to the confusion are the 'swimmers', which can indicate those who swim on the surface to a target, often with waterproofed bags of equipment, or can refer to the Swimmer Canoeists in the Special Boat Service (SBS) of the Royal Marines, who use diving equipment and can operate from submerged submarines and swimmer delivery vehicles. I have used the term 'frogmen' for the wartime period and for the units who still use the term, but otherwise use the term 'diver'.

Confusion can also be encountered between the terms 'canoe' and 'kayak'. Internationally, 'canoe' is accepted as being an open craft with the occupants using a single-bladed paddle to propel it, while a 'kayak' is an enclosed craft where the occupant sits in a cockpit which can be sealed to keep water out, and a double-bladed paddle is generally used. Following British convention, the famous military Klepper is referred to as a 'canoe', although in reality it is a 'kayak', so I have retained the use of the military term 'canoe' to describe either type of boat, unless a military unit specifically uses the term 'kayak'.

The expansion throughout the world of combat diver units has grown to the extent that even smaller nations have adopted the ability to use such forces. It has been impossible to include every combat diver organization in the world, so I have included a selection from a number of countries to represent the fact that all elite, special forces use similar equipment, select and train to harsh standards, and deploy on similar missions. Some have more advanced equipment at their disposal, some units have many hundreds of operators, while some might not even reach a hundred. Some use diving as a method of

The secret world of the combat diver who operates unseen and unheard in an alien environment. (Cobham Mission Systems)

infiltration, while others use it as a means to attack water-related targets or dispose of IEDs. There are those who model their units on the US Navy SEALs; others take the lead from the British SBS or SAS.

This is the story of the service personnel who, wearing different uniforms and cap badges, undertake gruelling and demanding training, with a high failure rate, in order to equip themselves physically and mentally to undertake tasks in an often black, cold, silent and alien environment under the water. It is not an encyclopaedia of military diving, or a professional handbook, but an insight into a secret world of those who go to war underwater, as attack divers planting mines, Explosive Ordnance Disposal (EOD) divers removing mines, or reconnaissance divers covertly infiltrating another country. I have been as factual and accurate as possible and acknowledge that there will be gaps in the information, but that is inevitable when dealing with highly secret units, their equipment and operations.

CHAPTER ONE

FROGMEN: THE BEGINNING

At the outbreak of World War II, divers in the British armed forces were well trained in the use of the heavy Siebe Gorman standard diving dress. Tried and tested over the years, it had proved its worth, and indeed is still in production today. It was heavy and cumbersome out of the water, and still required a team of men on the surface to keep one man underwater. Among the modernization items to the equipment was the mechanical air compressor.

The Royal Navy carried a diving team on all warships larger than a frigate, and in the case of capital ships, two or three teams. Restrictions were imposed by the bulkiness of the diver's equipment, and the lines which carried his air and telephone communications. All divers had to be familiar with hand signals on their lines, and during training the communication telephone was not used.

To work under a ship required dropping a rope over the bows, the ends being held by men who would then walk astern, either side, pulling the rope along. When in place, the rope would be pulled up tight, so that it ran from one side of the ship, under the hull and up the other side. The diver was dressed while sitting in a small ship's boat, or on a platform which was lowered from the ship's deck into the water. The rope was his shot rope, which he held on to, to guide and support him. If he needed to go for'ard or astern, the deck crews dragged their rope ends in the direction indicated. This laborious, time-consuming job of working on or inspecting the bottom of ships was accepted at this period, for no other equipment was available. The divers themselves were trained and familiar with the apparatus, and once skilled could perform many useful tasks.

But the first round in a new form of underwater warfare went to the Axis powers as early as 1941. The Italians had formed Decima Flottiglia MAS (the Tenth Light Flotilla), a unit whose leaders had speculated on the use of men sitting astride human torpedoes, a cigar-shaped craft with a detachable warhead, entering enemy harbours to attack ships at anchor. The first attack came at Gibraltar, which abounded in merchant vessels en route for the war fronts in North Africa, where they deposited fuel and stores for use by Allied warships and aircraft. Leading the unit at this time was Licio Visintini, the most idolized man in the Italian underwater assault group. On 19 September 1941 his plan was to force his way under the defensive anti-submarine steel net at Gibraltar's

harbour entrance. Aboard his torpedo (also referred to as a chariot) he carried compressed-air cutters and lifting gear, but he was lucky, for the net was lowered to allow a destroyer to pass and he was able to slip through in its wake. He left his chariot's warhead beneath a tanker, then forced his way under the net he had passed earlier and got away. Visintini made the Spanish coast and joined his equally successful companions. Clouds of smoke inside the harbour at Gibraltar confirmed that his charge had broken the back of the Royal Navy tanker *Denbydale,* and soon after there were similar explosions in the bay below the 10,900-ton cargo ship *Durham* and the 2,444-ton storage tanker *Fiona Shell.* The explosions were not spectacular, and people in the area heard only a loud 'thump'. The effect, on the other hand, was devastating, and for the authorities it was unnerving; three ships had been destroyed by unseen forces.

Surveys of the sunken wrecks using the British standard diving dress found the remains of a controllable underwater torpedo-shaped craft, the like of which had not been seen before, and some sets of a new and unfamiliar breathing apparatus, which was light in weight, self-contained, and closed-circuit so as not to give off any tell-tale exhaust bubbles. Both items were unknown to the Allies. The Italians made their way home to a jubilant reception, for their success was the start of a damaging new type of warfare.

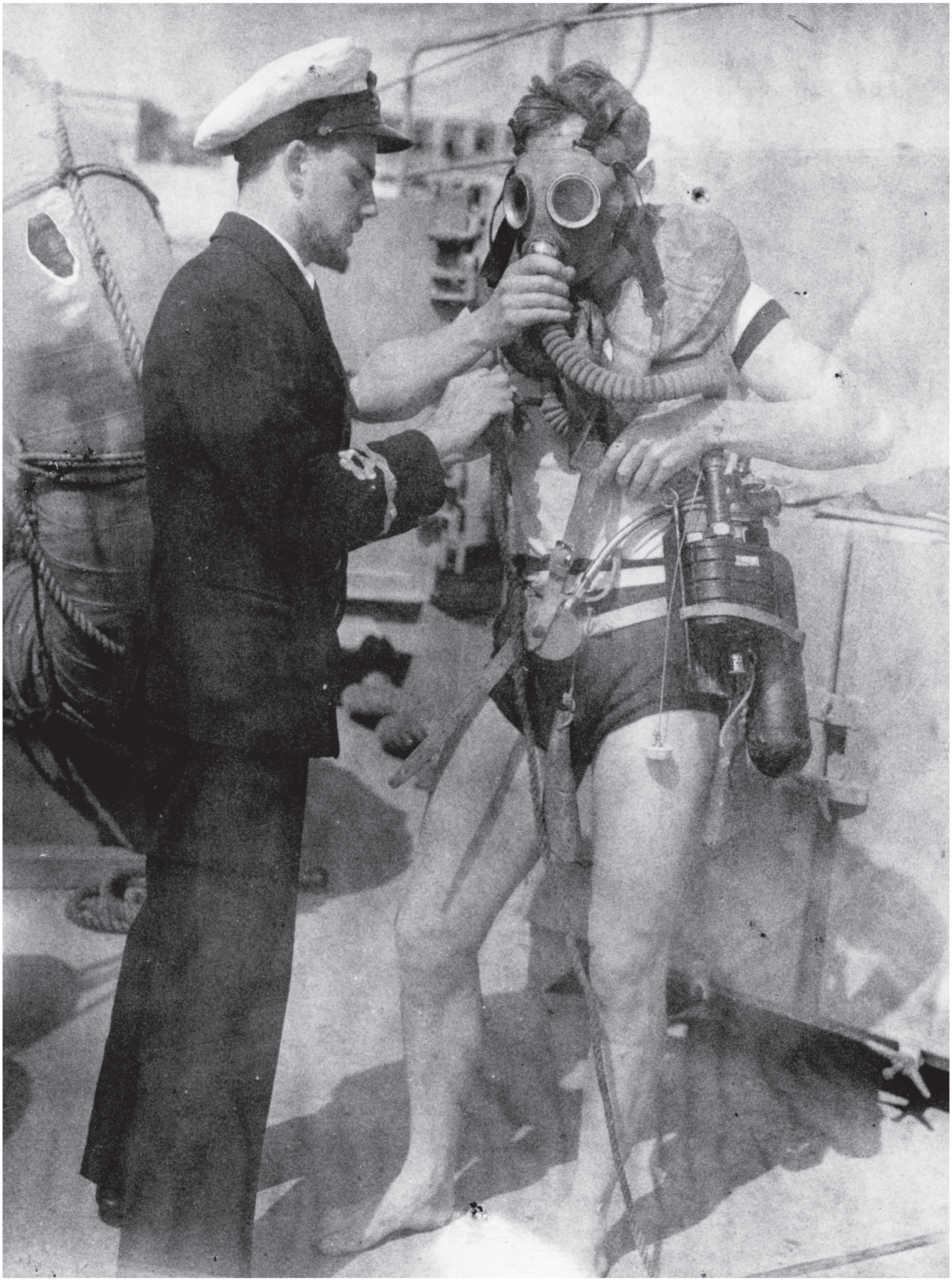
With Gibraltar being used as a key port in support of the Allied war effort in North Africa, merchant ships moored in the bay and were valuable targets for the Italians. The Royal Navy would have no choice but to endure the assaults by the Italian human torpedoes and frogmen, and try to provide defences against them.

The success of the underwater attacks by the Italians was the culmination of five years' work. Sub Lieutenants T. Tesei and E. Toschi of the Italian Navy had submitted plans for a human torpedo concept in 1935. Worthy of note is the fact that the firm of Siebe Gorman had developed a closed-circuit underwater breathing system, called the Amphibian Mark 1, and established a factory in Italy for its production during the 1930s after the British Admiralty had rejected all advances by the company, on the grounds that the standard equipment was safer, and the possibility of using free-swimming divers as combat troops was unthinkable. The Italians, on the other hand, had the foresight to utilize the equipment and develop a craft, thus forming the first underwater special force, leaving the Allies totally unaware of such developments.

The Admiralty reacted to the attack by asking Gibraltar command to provide an adequate counteroffensive. That was easier said than done, for the only diving equipment available was the standard diving dress, and to use that to search all the ships passing through the harbour at that period would have been impossible.

An Underwater Working Party was formed with Lieutenant Bailey and Leading Seaman Bell. They were tasked with the job of searching all ships entering the harbour, and if anything was found, rendering it safe. Apart from

OPPOSITE
Siebe Gorman developed the Amphibian Mark 1, a closed-circuit underwater breathing system, and established a factory in Italy for its production during the 1930s. (Royal Navy)



Training involved inflating the bag with oxygen, putting goggles in place, holding the mouthpiece between the teeth, and climbing down the ladder to submerge. After a few minutes, the diver would surface with training completed. (Royal Navy)

the heavy diving dress, the Davis Submerged Escape Apparatus (DSEA) was available, which had been designed by the Siebe Gorman Company to allow submariners to escape from damaged and submerged boats. The set was very basic and consisted of a flexible bag, which rested on the wearer's chest, a canister which contained a carbon dioxide absorbent, a rubber hose and mouthpiece, and a small bottle of oxygen. The wearer first opened the bottle of oxygen to fill the flexible bag so that, when he breathed in, oxygen would pass through the absorbent, up the hose and into his lungs. When he expired the breath, it returned back down the hose, through the absorbent and into the bag, the carbon dioxide having been removed. He could continue to breathe in this way for some time.

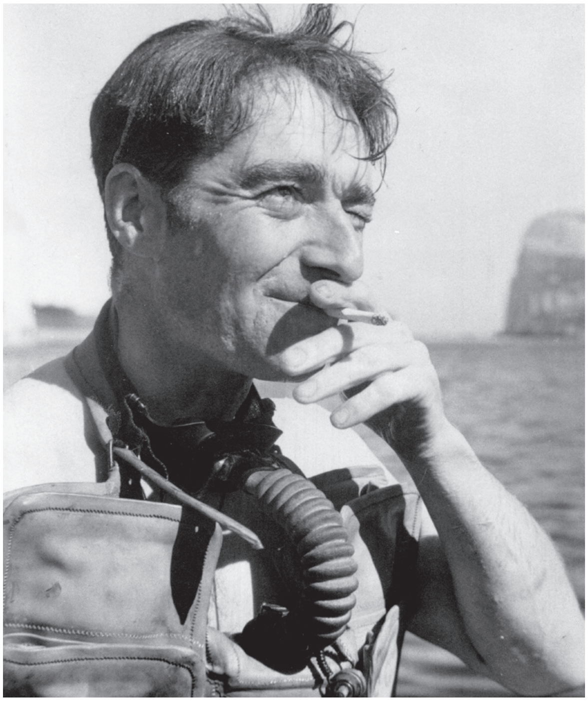
Bailey and Bell procured some of these sets, and trained themselves in their use. Dressed in swimming costumes, they would climb down a ladder into the water, and continue breathing. A small pair of goggles kept their eyes clear of the salt water as they moved about and ascertained the limitations of the apparatus.

On the surface they learned how to charge the oxygen bottles. Nobody knew how to maintain the equipment, so they did not bother. Training was done in a single day, the final phase being to ride a launch out to a ship, then jump into the water and, using breaststroke movement, make their way to the bilge keel of the ship. They were free to move in any direction, and did so, looking for anything that was not meant to be there. The task completed, new recruits were duly made members of the Underwater Working Party.

Bailey had one genuine claim to a first: while inspecting the underside of a ship he observed a shape moving through the water. He thought it was a fish but soon saw that it was another frogman. Certain that it was not a friendly one, he drew his knife and attacked. The knife penetrated the frogman's rubber suit, but before Bailey could do more damage, the enemy swam away, aided by the flippers which British frogmen lacked at this time.

When the war had broken out in 1939 one man the Royal Navy had not wanted was Lionel Kenneth Philip Crabb, and so he accepted a position in the Merchant Navy as a gunner, and in 1940 he wrote to his mother explaining that he did not know what to do, as he still wanted to go into the Navy, and even accepted that he would be 'lower deck'. In the autumn of 1940 he decided to try again for the Navy, and this time he was successful and entered as a gunner. In 1941 he was commissioned, despite the fact that the Navy found that he had a problem with one eye. Fearing a mundane job, he volunteered for 'special duties' and attended an interview, following which he was accepted. Thinking that the real adventure would now begin, he was appointed the Drainage and Passive Defence Officer of the coastal forces base at Dover. He felt let down, as he would see less action than he had as a gunner on a merchant ship. He was at a low ebb when he met up with a friend who was sympathetic to his problem and suggested mine disposal. It was a risky job, but offered more action than drainage and from that conversation Crabb converted from drains to mines and bombs, and was posted to Gibraltar after his training.

Lieutenant Lionel Kenneth Phillip Crabb RNVR (Special Branch) in Gibraltar. (Royal Navy)



In 1942, now-Lieutenant Lionel Crabb RNVR (Special Branch) took up the duties of principal mine and bomb disposal officer in Gibraltar. His superior officer was Commander Ralph Hancock, who was in command of minesweeping and extended defences. During the meeting when Crabb was briefed on his duties, he was informed of the exploits of the Italian underwater attacks against the ships berthed in the Gibraltar area. He was told of the work undertaken by the Naval Underwater Working Party, whose role was to search the undersides of ships and recover any mines or warheads they found. Hancock explained that when the divers found a device they would remove it and bring it to the surface where it would become Crabb's responsibility to dispose of it. Crabb reflected on the huge task of searching the undersides of ships in deep water, in all weathers and during day or night, never knowing when a mine might explode.

He assumed there must be a large and highly trained underwater party for such a task, and ventured to ask Hancock how many divers were available, 'Two', was the astonishing reply, 'they are not professional divers, they are not mine disposal people and they have no proper diving gear.' He introduced himself to the two divers, Lieutenant Bailey and Leading Seaman Bell, and soon discovered what 'no proper diving gear' meant. Instead of the protective rubber suits used by the Italians, all they had were swimming trunks and overalls; instead of flippers, they wore plimsols; and instead of proper diving masks and breathing apparatus, they had 'scrounged' DSEA designed to help submariners escape a sunken submarine. As was his nature, Crabb decided that since he was the principal mine disposal officer he ought to join these men in their underwater task, even though he was not a strong swimmer. So he undertook his diving training in Gibraltar harbour. Dressed in a pair of overalls and gym shoes, he was introduced to the DSEA. Donning the set, he climbed down the ladder to the water's surface. Then, putting a pair of goggles in place and the mouthpiece between his teeth, he continued down the ladder. Below the surface he gained confidence in the ability both to breathe and to move about underwater. Returning to the surface, he found his introduction was short lived as the alarm was raised, indicating that a ship needed inspection. Crabb required no encouragement and joined the other two divers on the job. He dived under his first ship, beginning an underwater career that was to make him a legend in military diving.

Meanwhile, Commander Pierleoni, an Italian Naval officer, had previously been sent to Spain to direct sabotage activities under cover of a consular appointment in Barcelona, which allowed him to spend the winter of 1941–42 building up a sabotage organization in the country. Although Spain was supposedly neutral, every seaport consulate had a radio station reporting Allied

A member of the Underwater Working Party removes a device from the underside of a ship. He wears only swimming trunks and plimsolls and uses the DSEA. Rubber diving suits and fins were things of the future. (Royal Navy)

shipping movements to the Embassy in Madrid. At Algeciras and La Línea, rooftop observatories kept up a constant watch on ships and aircraft coming and going at Gibraltar.

The Italians moved their scene of operations to Alexandria where, for some reason, no Underwater Working Party for the inspection of ships at harbour had been established. It appears that the reality of underwater attack had not been fully accepted. The main Italian targets were the battleships *Queen Elizabeth* and *Valiant*. On 19 December 1941, six men and their three small craft were carried within range by submarine, where they were launched and headed for the harbour. Slipping in unseen, two of the craft made for the two battleships while the other made for a tanker; although the crews were captured, two of them by the *Valiant*, the Royal Navy did not know if their task had been successful until the charges detonated, crippling the three ships, as they had no divers to inspect the ships.

While the specialist underwater teams began to develop new equipment and train in the frogman underwater swimming apparatus, the results of the Italian underwater attacks left Alexandria harbour blocked with sunken ships. These wrecks had to be removed and it fell to the Navy and Marine divers to do the job, using the conventional standard diving dress. The ships lay on the bottom, many on their sides, and had to be cut and levelled by the use of explosive charges.

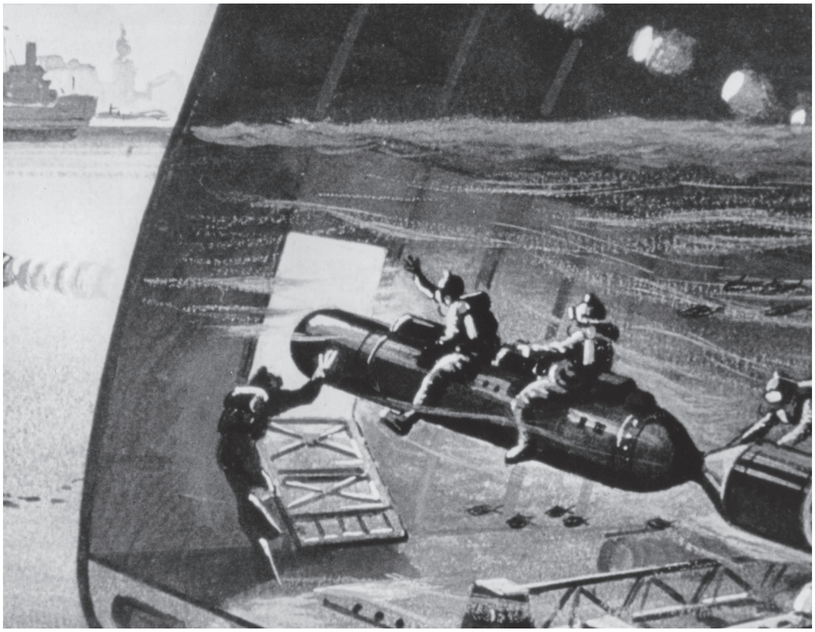
When there were a large number of Allied ships moving in and out of the area the Italians decided to launch underwater attacks, and a team from the Tenth Light Flotilla of 12 Gamma swimmers was ordered to Spain. Six were carried by submarine before infiltrating ashore. The other six were signed onto a merchant ship as seamen, deserting when docked at Barcelona and, through the effective network that was in place, were then taken to a safe house on the coast, overlooking the bay and their targets. Plans were made at the house for attacks against the ships that lay close to them. The British were looking for human torpedo attacks and directed their defences out to sea. The Gamma group was to sneak in through the unsuspecting and relatively undefended rear. The team had an unsurpassed view of the ships, and each swimmer could identify a target. On the night of the operation the 12 men, dressed in their rubber suits, fitted the underwater breathing equipment and placed the fins on their feet. In the water they towed the mines, which were fitted with a rubber ring. The ring kept the mine afloat during the swim, and when placed under the ship the swimmer could inflate it so that it held the mine fast against the ship. Under cover of darkness the swimmers made good progress and reached their targets, which included the merchant ships *Meta*, *Shuma*, *Baron*, *Douglas* and the *Empire Snipe*. Each swimmer dived down and fitted a mine to a ship, before surfacing and beginning the long swim back to Spain and relative safety. From the confines of the safe house the swimmers were able to observe the results of the operation as the mines exploded, sinking Allied ships.

Meanwhile Visintini, seeking new ways of attacking the ships in Gibraltar, came up with the idea of making a human torpedo base inside the *Olterra*, one of two Italian tankers detained in British contraband control anchorage in Gibraltar Bay when Italy entered the war. A few minutes before the declaration of war, both ships' captains had received secret radio signals to scuttle their vessels. Although both ships were later towed to Algeciras harbour, in 1942, the *Olterra* was lying at a lonely breakwater berth just inside the harbour entrance.

Under Visintini's direction, the Italians cut a 25-foot-long section of the steel bulkhead separating the bow compartment from a small cargo hold, and hinged it like a coffee stall front. Then, telling the Spanish neutrality guard that they must clean the trimming tanks, they pumped out the forward tanks till the bows rose high out of the water. Early one morning, while the brandy-soaked security guard was sound asleep in the galley, a four-foot door was cut in the side of the ship, opening into the bow compartment six feet below the normal waterline. It was hinged to open inwards and so neatly done that only a diver could have detected it. When the ship resumed its normal trim, the bow compartment was flooded but the hold was still dry. The plan was to sling human torpedoes on pulleys in the bow compartment. On the night of an attack, they could be lowered into the water, pass out of the ship through the door in the side, do their job and return to the secret base. The next part of the plan was to secretly bring the human torpedoes through Spain, with the 500lb warheads disguised as parts needed for an engine overhaul. With this done, the team was ready for the next attack.

On the night of 7 December 1942, Visintini stood on the bridge of the ship with his team and pointed out the silhouettes of two battleships and two aircraft carriers of Force H inside Gibraltar harbour, five kilometres away. They left the safety of the *Olterra* and began their attack. It took them several hours to reach the harbour approaches, and all the time they could hear through the water the thud of small charges exploding by the harbour gate. They had to gamble on getting through between charges. Visintini and his companion, Petty Officer Magro, paid with their lives; killed by the explosive charges dropped at the gate, their bodies were found inside the harbour two weeks later. Two other members of the team were captured and one drowned, so that night the Italians lost five men and gained nothing. Visintini and Magro were buried at sea with naval honours. Crabb managed to find two Italian flags and a priest to officiate. There was one wreath, which was thrown on the sea by Crabb and Bailey, the British officers whose task it had been on that night to search the ships' bottoms after the attack, knowing that at any moment a warhead explosion within half a mile might kill or maim them. It was a generous gesture, much misunderstood and criticized by others at Gibraltar.

One of the Gamma swimmers, Giari Vargo, volunteered for special service and went to La Spezia to be trained as a frogman. He became a non-commissioned officer in the Gamma Brigade and was one of the first of



Using chariots and operating from a modified ship located in Spanish waters, the Italians were able to penetrate Gibraltar harbour to inflict serious damage. (Royal Navy)

12 members of the Brigade to be clandestinely infiltrated into Spain. They were to take the war to the Allies in Gibraltar and even into Spanish ports. Their covert attacks were successful largely due to the fact that the Royal Navy expected attacks from submarines at sea, although it was known that the Axis forces were able to operate in Spain with little harassment. Britain did not have combat frogmen and so there was no counter to the threat, apart from dropping depth charges or other explosive charges, which is not always effective if you do not know where the enemy is or where he is coming from.

The underwater war continued, with the Italians attacking, and Crabb's team was expanding with many volunteers being selected to increase the defences. It was becoming more difficult for the attackers and they were subjected to greater losses, often without even gaining access to a target. Eventually Gibraltar was considered too well-defended and the attacks ceased, and for Crabb it was the end of one era and the beginning of another.

In the summer of 1944 Crabb was promoted to lieutenant commander and ordered to select one of his divers and proceed to Italy. Italy had surrendered to the Allies on 8 September 1943 and one month later declared war on Germany. He chose Sydney Knowles, who had joined the Gibraltar team in 1943, and they departed the now much quieter Gibraltar to join the Joint Services Intelligence Collecting Unit, which was based in Florence. The mines that Crabb and his team had been disarming had originally been produced there and he soon became an authority on the mines, as well as warheads and operations of the Italian Tenth Light Flotilla. Crabb had waged his war against this unit and was now carrying that fight into their homeland.

In Florence, Crabb and Knowles teamed up with Lieutenant Tony Marsloe, an American of Italian descent who was a member of the US Navy Reserve. He was a trained intelligence officer and spoke fluent Italian. One of their first tasks was to interrogate a former Italian Naval officer from the Tenth Flotilla who had joined the partisans to fight the Germans after Italy's surrender. He provided details of a new type of mine that would cause the divers a great deal of trouble when they tried to disarm or remove them. He also stated that pro-German members of the Tenth Flotilla had regrouped and would continue their underwater attacks against captured ports and the Allied ships in them. This was news to British Naval Headquarters, who decided to pull Crabb (and his team) away from the Intelligence Collecting Unit and give him the job of supervising anti-sabotage diving operations in the whole Allied-controlled northern part of Italy.

Crabb and Knowles moved to the Italian port city of Livorno where another Italian, Sub Lieutenant Ventiorini, who became a stalwart member of the team, joined them for diving operations. Command of all anti-sabotage diving in northern Italy was a monumental risk, but Crabb was fortunate when other members of the Tenth Flotilla joined them. Those who joined him found an understanding leader, for he allowed his prisoners considerable freedom; as the divers were required to dive at any time and at any location they had to remain flexible, so his Italian divers were not locked up, often against the wishes of his superiors.

In March 1945, after two months in hospital with jaundice, Crabb re-joined his team and immediately Tony Marsloe discovered from the partisans that some former members of the Tenth Flotilla had set up a base for training Italian and German frogmen in the use of human torpedoes on the small island of La Vignole. It was no longer operational, but was guarded by two sergeants who refused to surrender to the communist-led partisans for fear that their valuable equipment would ultimately fall into Soviet hands. Crabb and Marsloe were, however, able to secure the base and the services of the two sergeants. Crabb learned from these men that the partisans had a very important prisoner in the form of Commander Angelo Belloni, who had designed much of the Italian diving equipment used during the war. In fact it was he who had persuaded Mussolini to form the Tenth Flotilla. Crabb negotiated to have him released, and Belloni joined the growing underwater work group.

Crabb, as the principal diving officer in the area of northern Italy, was next ordered to secure Venice from mines and to open the port to Allied shipping, and was faced with the largest mine-clearing task of his career. His command included Tony Marsloe as his number two, Angelo Belloni in charge of equipment, a doctor and other divers. They were very successful, even devising measures against magnetic mines which could be set off by the presence of their metal air tanks.

When the war with Italy ended, Crabb personally accepted the surrender of one of the Tenth Flotilla's leaders, Lieutenant Eugenio Wolk, who had

continued to fight the Allies, both working with and training the Germans. Now he was to lead many men of his former unit in searching for those German mines. Technically he was a prisoner, but working for Crabb he was a prisoner who went home to his wife and family in the evening. He often stated that his men never carried arms and that the limpet mines were too small to endanger the crews of the ships. 'Only our own lives were in danger,' was his argument, forgetting the British Naval divers who had made it their business to seek and remove the charges. Yet, when the day came after the armistice for him to be judged for his anti-Allied work, one letter preserved his liberty; it came from Lieutenant Commander Crabb.

In December 1945 Crabb was ordered to Naples with his diving equipment, where he was briefed on a new job, helping overcome the terrorist bomb problem in Palestine where militant Jews were trying to expel the British in order to establish their own homeland. British ships and police launches were prime targets, and teams of frogmen made limpet mine attacks against them. Crabb's task therefore was to go to Palestine and establish an underwater bomb and mine disposal working party. He had only just arrived in the country when he was awarded the OBE for his work in Italy. The task of the team was that of searching the undersides of ships as they had done so many times before in Gibraltar and Italy.

It was not until the spring of 1947 that Crabb was finally ordered home, and a year later he walked out of a demobilization centre in Portsmouth with a cardboard box, which held a grey chalk-stripe flannel suit. This was a change that Crabb did not like or accept, but it was a brave new world.

Formality replaced informality after the war, which was a period of great change for divers in the Navy. There were structured training courses, standardization of diving equipment, formal annual fitness medicals, and they abided by formal orders and procedures. It was actually in 1950 that a Home Station Clearance Diving Team was set up, with other clearance diving teams established soon after, to support the Mediterranean Fleet and the Far East Fleet. In 1951, clearance diving training moved to HMS *Vernon* and a new Clearance Diving School was established, combining the training of clearance divers with that of deep divers. The latter used the heavy standard diving equipment that did not have the flexibility of the 'self-contained' swimmer. This school also took on the new task of training ships' divers so that every ship had a properly equipped air diving capability under its own Diving Officer to conduct ship's bottom searches and undertake simple underwater engineering tasks. The Clearance Diving (CD) Branch was officially formed under an Admiralty Fleet Order on 7 March 1952, although a training nucleus had been set up some two years earlier to take advantage of the few remaining men with wartime experience. These officers and ratings had, in the main, qualified as Shallow Water Divers trained to use the Sladen 'Clammy Death' diving dress and oxygen breathing apparatus.

CHAPTER TWO

EXPERIMENTAL DIVING

The decision to proceed with human torpedoes, midget submarines and untethered frogmen in early 1942 posed a number of problems, apart from the need to design machines, suits and underwater breathing apparatus. One of these was the use of oxygen at various depths. To address the situation the Admiralty Diving Committee under the chairmanship of Rear Admiral R.B. Drake CB, DSO, established the Admiralty Experimental Diving Unit and based it at the Siebe Gorman works at Tolworth in Surrey. The facilities available to the team included three cylindrical tanks, one 3.5m deep and 3.5m in diameter, one 7.6m deep and 1.8m in diameter, and the third 3.5m deep and 1.8m in diameter. A fourth chamber, which became infamous to all those concerned, was the 'pot'. This chamber had a small opening in the top, and contained eight feet of water, the upper four feet of the tank being dry. This was the place where divers would be subjected to different water depth pressures, up to a maximum of 45m.

Diver experiments using underwater breathing apparatus in the 'pot' pressure chamber to evaluate the reaction of the diver breathing oxygen at depth. (Royal Navy)

The unit that arrived at Tolworth comprised 16 experimental divers, with diving officers, instructors, medical staff and other relevant personnel required to run the unit and carry out the experiments. Two of the principal senior staff were the medical officers, surgeon Lieutenant Commanders K.W. Donald, DSC, MD, RN, and W.M. Davidson, MB, BCh, RN, and the whole of the operation came under the direct control of the Superintendent of Diving.

The volunteer divers, who had answered the call for 'hazardous duties volunteers', found themselves subjected to medicals and interviews and were selected for the job before they even knew what was required of them. The object of the experiments was to determine the safe working depths of oxygen when breathed underwater, as well as individual tolerances. Professor J.S. Haldane was heavily involved and controlled many of the experimental dives. No doubt it was an unnerving experience for the individuals undertaking the experiment.

Each diver was lowered, dressed in closed-circuit underwater breathing apparatus, into the water in the pot, while an attendant entered the top section and controlled the lifeline. Then the steel door was closed, two heavy and strong steel backing plates were set into place and the door bolted shut. Finally a hammer was used on a spanner to make sure the bolts were secure. The sound of the hammer would echo around the small steel area, indicating that the diver was firmly locked in and could not be released very quickly in the event of trouble. The chamber was then pressurized to equal a water depth of 15m, the diver remaining under the water breathing oxygen. When his lips began to tingle and twitch, he would move them around the mouthpiece until the sensation disappeared. He would remain in the chamber for a set period, or until he passed out. The attendant would assist until the hatch could be opened and the diver taken out to recover. Aware of the strains they were placing themselves under, the divers invented a demon whom they christened 'Oxygen Pete' who would seemingly creep up and take them over, so they competed to see who could avoid Pete the longest.

More than a thousand such dives were undertaken, often resulting in the divers suffering convulsions and unconsciousness. Their courage was rewarded by the additional payment of five shillings per day!

The Royal Marine Boom Patrol Detachment

Prior to the attack on the capital ships in Alexandria harbour, Captain H.G. 'Blondie' Hasler, Royal Marines, who was serving with the Mobile Naval Base Defence Organization, formed in 1942, had put together a proposal and submitted it to the appropriate authorities. This proposal would involve the use of canoes to carry men dressed in flexible rubber diving suits into enemy harbours, who would then place mines on the unsuspecting enemy ships. The Admiralty rejected his proposal. Hasler was not deterred, like other military visionaries such as David Stirling and Orde Wingate whose own unorthodox ideas had also faced rejection and delayed action, but had persevered until their concepts found the right desk.

Hasler took his papers and rewrote them, adding that such underwater trained swimmers would be able to undertake beach reconnaissance and to mark and destroy underwater obstacles, especially in probable landing areas. He presented the revised proposals, and waited for some response. None came. The papers moved from desk to desk, department to department. Ironically, it was the Italians who made the decision, in a roundabout way. After their successful attack on the two battleships in Alexandria, demands came from the highest quarter of the Royal Navy for explanations as to why the raids had been so successful, what the Navy was doing to counter them, and even more importantly, why the British did not have the capability to carry out such raids in return. The faceless bureaucrats who had passed Hasler's papers around

RMBPD's close-fitting rubber diving suit enabled the wearer to move freely underwater and while using canoes and other small craft. (Royal Navy)

hastily found them, and presented them for approval; they were duly accepted and Hasler was called to develop a unit which could carry out the raids he had described. The unit would consist of Royal Marines as they had links with the sea and most had one other very useful commodity: being commando-trained. Every man was to be a volunteer, and it was agreed that Hasler should command the unit. The unit was trained for the purpose of undertaking raids using small craft and developing a new form of underwater swimming.

Formed in Portsmouth during June 1942, the new unit bore the name of Royal Marine Boom Patrol Detachment (RMBPD), a name created to give the impression that it would patrol and maintain the defence booms at the entrance to Portsmouth harbour. Secrecy was to be the byword for the unit. It was in fact the birth of the Royal Marines Special Boats Service and the swimmer canoeist specialization.

The RMBPD procured the only underwater diving dress available, the Sladen suit and the Davis Submarine Escape Apparatus (DSEA). The suit was unsuitable for what Hasler had in mind, as it was too loose fitting, being made of thin silk and rubber, even though it covered the body (sealing at the wrists) and incorporated a hood with a small fixed-glass face piece which could if required be lifted up. Roughly made canvas boots were worn, allowing the wearer to walk or crawl around the bottom. A large breathing bag was attached to the chest and was connected to the hood by a gas mask breathing hose pipe. Two large oxygen bottles were carried on the back, these in fact being products of Germany! They were made of an aluminium alloy which was highly suitable for underwater use, but with this being unobtainable in wartime Britain they were removed from shot-down German aircraft. RMBPD submitted instead a design for a thin, flexible, close-fitting suit, which would enable the wearer to move freely, climbing in and out of canoes and other small craft, as well as being easily fitted and keeping the wearer dry.

The Admiralty Diving Committee reviewed RMBPD's design and was sceptical, due to concern over how the diver would keep warm. However, Hasler insisted that his design needed to be implemented if he was to do the job he had been delegated. So, he was eventually introduced to the Dunlop Rubber Company, where the problem was presented. Dunlop had no experience with the manufacture of diving suits at the time, but were involved with balloons and flying suits. The end result was a close-fitting suit of rubberized stockinet, which had a neck flexible enough to allow a man to enter through. Rubber cuffs completed the seal at the wrists, and so kept the wearer dry. A separate hood was developed to enable the wearer to use underwater breathing apparatus, or not, as required. The divers solved the problem of keeping warm by wearing long underwear and a thick woollen under-suit.

Since World War II the SBS have used the canoe as a method of transport for clandestine warfare. One man gets out and keeps watch while covering the other man, who then joins him. The canoe can be hidden in the undergrowth or by sinking it. The picture is dated, as the operative is equipped with a silenced Stirling sub-machine gun of the 1960s, but the humble canoe used during the war is still in service. (Royal Navy)

The bad points of the DSEA had also been discussed and ideas of improvement submitted. A new and much improved underwater breathing set was therefore produced, which was more comfortable, consisting of a pair of rubberized breathing bags mounted on a rubber jacket. The two oxygen bottles were situated on the front, under the bags. The wearer fitted the set over his head, so that it rested on his shoulders. The principle of the new set was the same as that of the DSEA and had the single hose, pushing and pulling the oxygen through a canister of carbon dioxide absorbent. It was again closed circuit, and gave off no tell-tale exhaust bubbles which would betray men swimming underwater to an alert enemy defence.

RMBPD gained an addition to its ranks in the form of Lieutenant Commander Bruce Wright, a Royal Canadian Naval officer. He had given much thought to the use of swimmers to gain access to enemy harbours and attack their ships, and introduced two new invaluable items to aid them. He knew that the Abalone divers in California used rubber extensions on their feet and a rubber mask that fitted over the face with a single glass plate in the front.

He had a mask with him but the fins, which were in his main baggage en route to Britain by sea, were lost when the ship was sunk. Further face masks were made, using the original as a model, while fins were produced from drawings. The RMBPD was elated, for these new items would complete the equipment for an underwater swimmer. Hasler's operatives, skilled in the use of canoes and paddling rubber inflatable boats, trained with the underwater equipment to complete the final part of their clandestine raiding programme, using Eastney Swimming Baths (when closed to others) and Horsea Lake for training.

Axis vessels were running the blockade from Bordeaux in France, which was a vital supply route for the enemy. Hasler had already proposed how an attack could be made and now his proposal was taken up. The plan was for six canoes to be taken to the area of the Gironde estuary by submarine. They would then paddle by night to Bordeaux and place limpet mines on the docked cargo ships. After the attack they would abandon their canoes and escape overland to Spain. Hasler was ordered to lead men from the unit on Operation *Frankton*, an attack on the ships loading in the port of Bordeaux, which lies some 100 km up the River Gironde, and was to provide the target for RMBPD's first canoe/frogman raid.

Hasler's first task was to select a team of Royal Marines who he deemed possessed the right mental and physical qualities for the operation planned. Having found the 12 men they began secret high-level training in both canoeing skills and underwater swimmer operations. They learned about the limpet mine and the best location to place these on a ship to cause the most damage. They were taught escape and evasion techniques as well as survival, which they would use in their canoe pairs. Once a date was set for the operation the team moved to Scotland, where they prepared to join the submarine that would carry them on the first part of their journey.

On 30 November 1942 the Royal Navy submarine HMS *Tuna* sailed with the six canoes and the 12 raiders on board. The plan was for the submarine to reach the River Gironde estuary so that the mission could commence on 6 December 1942. There was a delay because of bad weather en route, the need to negotiate a minefield, and the difficulty of obtaining an accurate fix on the relatively featureless French coast. By 7 December the submarine had reached the Gironde estuary and surfaced some 16 kilometres from the mouth of the estuary. They began the task of getting the canoes on deck and crews into them. One canoe's hull was damaged while being passed out of the submarine hatch, which left only five canoes to commence the raid. The team had a reserve member and he was not needed, so he remained aboard the submarine with the crew of the damaged canoe.

The five remaining canoes departed the submarine, which submerged once the canoes were clear. Haslar's plan was for the crews to paddle, with a rest for five minutes in every hour. That first night they fought against strong cross tides and crosswinds which stirred up the water and caused one canoe to

disappear. Those remaining continued, before conditions worsened and they encountered high waves and another canoe capsized and was lost. The crew survived and held on to two of the remaining canoes, to be carried to calmer water where Haslar left them to get ashore and escape. Carrying on with the raid, the canoes approached a major checkpoint in the river and came upon German warships. In the dark, and lying flat on the canoes, they paddled silently by without being discovered. On the first night the three remaining canoes had covered some 40 kilometres since leaving the submarine.

Unknown to the remaining canoes, the two Marines from the capsized canoe had been captured at daybreak where they had come ashore. The enemy now knew that something was happening, but as the men did not reveal any information they did not know any details. German forces searched the area where the first men were captured, but by the end of the second night, 8/9 December, the three remaining canoes had paddled a further 40km towards the target, and on the third night they paddled a further 25km, but on the fourth night, because of the strong ebb tide they only managed to cover 15km. The original plan was for the attack to be on the 10 December, but Hasler changed the plan because the strength of the ebb tide meant they still had a short distance to paddle. They hid for another day before setting off to reach Bordeaux on the night of 11/12 December.

The four men who reached the docks found the enemy ships and prepared to undertake the final attack, with the frogmen dressed in the underwater equipment sitting in the front seats of the canoes from which they had to carefully extricate themselves and gain access to the water. The canoeists remained in their boats, keeping the crafts in the shadows, and passed the primed limpet mines to the frogmen. As they worked around the ships, enemy guards patrolled above them and on harbour launches. Each frogman, holding his mine, would submerge alongside a ship's hull, to find the delicate area near the engine room, then clamp the mine on to the steel hull plates. He would then surface carefully, and move to the next location.

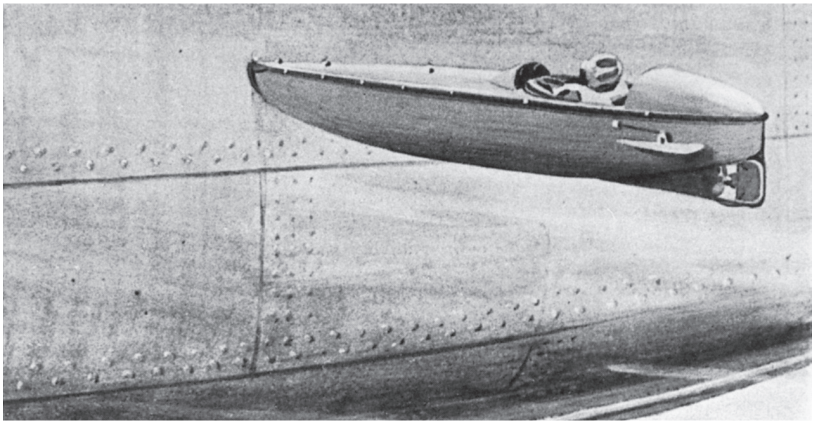
One canoe was spotted by the defenders and a game of cat and mouse began until virtually all were caught. Of the ten men who had left on the raid, only two were to return, Hasler and Marine Bill Sparks, and that was after using the overland escape route. The other eight were shot, following Hitler's directive that all 'special forces' troops were to be categorized as saboteurs and spies, and dealt with as such. From the two remaining canoes, 16 limpets had been successfully placed, with the result that one ship was sunk and four were seriously damaged, so the raid was considered a success, despite the loss of the men, and conclusively proved that both the canoe and frogman could be used in clandestine operations.

While the RMBPD carried out the raids for which it was raised, it also became involved in experiments. One involved a small motor boat, designated the Boom Defence Boat, which was adapted to fit into a Lancaster's bomb bay.

NEXT PAGES
Hasler and Sparks begin their attack on the German ships in Bordeaux. Sparks keeps the cockle on station in the ebb tide with his magnetic handhold, while Hasler begins to lower the placing rod holding the magnetic limpet mine into the water. They work carefully to avoid risking one of the large magnets being drawn onto the steel plates of the vessel with a resounding boom which would alert the ship's crew above. (Artwork by Howard Gerrard © Osprey Publishing)

CATFISH

CATFISH



An artist's impression of what was termed a 'Sleeping Beauty' motorised canoe. It carried a single diver/frogman on the surface and then underwater for the attack. It carried explosive devices that could be attached to the hull of a ship or other targets. (Royal Navy)

Over the target area, the diver would climb into the craft, wearing underwater breathing apparatus and a personal parachute. At 1,500m, the craft would be launched into the air. Three parachutes would then deploy to lower the craft to the sea below, disengaging themselves once the craft was afloat. Although the diver wore a personal parachute, it was very much doubted if he would ever be able to extricate himself from the craft to use it. During 1944, drops with men on board were successfully made, but if the system was ever used on a raid, there are no detailed records.

A more successful experiment was undertaken with a motorized submersible canoe, known to those involved with it as the Sleeping Beauty. It was constructed of mild steel plate and aluminium, almost 3.9m long and with a beam of slightly more than 60cm. It was driven by an electric motor, drawing its power from four six-volt car batteries, and could attain a speed of some 4.5 knots on the surface, and 3.5 knots when submerged. It dived to an operational depth of up to 12–15m. It was remarkably stable and easy to operate. Carrying one anti-capital ship charge, or a number of limpet mines, all of which were suitable for handling underwater by the operator, it made a versatile attack platform. The risk of detection was less than with an ordinary canoe because of its size, its low profile and lack of paddle movement, combined with its submerged final approach. As far as is known, it was never used operationally, but one thing the experiments do show is the dedication of the underwater swimmers to develop methods of attack.

Human torpedoes

In 1942 the Admiralty ordered the formation of a human torpedo unit. Using the captured remains of Italian human torpedoes, Britain set about the task of developing similar craft. Under Commander W.R. Fell, RN, the new unit called for 'special duties' volunteers. Selections were made, and the volunteers were sent to Portsmouth to begin their training, first in the use of underwater

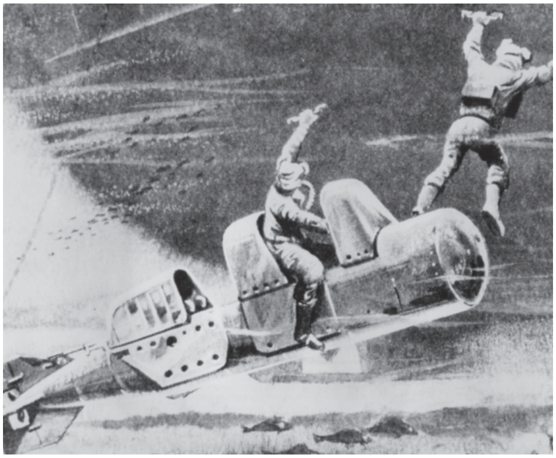
diving equipment and then in the operation of the new 'torpedoes'. Physical training strengthened the men, who were also introduced to the water using the Sladen suit. To produce a team spirit the officers would assist the other ranks to dress, and the men would then submerge into the water to gain experience and confidence in their equipment. The roles would then be reversed, and the other ranks would help dress the officers. The physical training and diving combined to produce the nucleus of Britain's first human torpedo teams, the 'Charioteers'. They did not have a torpedo to train on, as these were still in the production stage, but a mock-up was produced, to give the training more authenticity.

With completion of diving training and the delivery of the first production models, the unit moved to Scotland. In Loch Corrie the men were introduced to the new craft, called by the British 'Jeeps', or 'Chariots'. They were cylindrical, with a rudder, hydroplanes, and propeller at the tapered tail. The fore end held the explosive warhead, and the design allowed the craft to run underwater without it. Two seats were fitted which allowed the crew to sit astride the torpedo (future developments would allow the crew to sit inside a cockpit, thus streamlining the shape). The front seat had the diving controls, luminous depth and pressure gauges, and the vital compass. Inside the body were the main battery, electric propulsion motor, air tanks and ballast pump. The craft had an operational speed of 2–3 knots. As with swimmers, compass bearings were taken as line of sight and any magnetic interference caused by mines or clamps remained constant.

A team consisted of a pair: number one, who sat in the forward position and controlled the craft; and number two, who sat in the aft position and undertook the task of fixing the charge to the bottom of an enemy ship. The pairs began their training on the torpedoes on the surface during daylight. Progressively they would submerge until only their heads were out of the water, and then they would go completely below the surface.

BELOW LEFT
Two British Charioteers with their craft on the surface while ready to submerge. (Photo by The Print Collector/Getty Images)

BELOW
A painting depicting two British Charioteers with their craft attacking an enemy ship. (Royal Navy)



Once under the water, number one controlled the ballast, and guided the craft by using the compass. As they became confident, the submerged runs became longer, and training involved avoiding detection by a keen surface group who searched for the charioteers in surface vessels. Once they could handle the craft efficiently and guide them unseen to a target, they were introduced to the defences, in the form of anti-torpedo and submarine nets. These would require the number two to dismount and use heavy cutters to make a hole large enough for the craft to pass through. Although light did not penetrate very far down, it gave enough illumination for the charioteers to make out shapes in the gloom. Now the skills they had learned in daylight had to be re-enacted at night, for clandestine underwater attacks were done in the hours of darkness. The charioteers had to penetrate the nets, then proceed to the target. They would surface enough to allow their heads clear of the water, to gain a compass fix, then submerge and run underwater on the bearing. The surface party looked for them, searching with torches. The charioteers became more and more efficient. If they were found at this stage, only a torch beam shone on them; inside enemy lines, however, machine guns and depth charges would be trained on them.

The British method of chariot attack differed from that of the Italians, in that the British would manoeuvre their craft alongside the enemy ship and use powerful magnets to hold them in place. By moving the magnets down, they were able to guide the torpedo into position, where the warhead was secured to the magnets and disengaged from the craft, which was then able to move away. By contrast, the Italians drove their torpedoes under the ship, then released ballast until they came to the ship's bottom, where they would secure clamps on either side of the ship's bilge keel. A line ran between the two clamps and it was to this that the warhead was secured, to be left hanging below the hull, primed to detonate after the torpedo had left the area.

In June 1942 Special Operations Executive (SOE), under whose wing the charioteers operated, were approached by the Navy and asked to cooperate in a plan to attack the German battleship *Tirpitz*, a great menace to Allied merchant ships, while it lay at Trondheim fjord in Norway. The plan was formulated and agreed. A motor fishing vessel, the *Arthur*, was to be used as the support craft, to carry two chariots and crews across the North Sea to Norway. The chariots were then to be launched and towed through the German controls to an area where the crews could board their craft and undertake the attack. Papers were forged to allow the *Arthur* to continue as if about lawful business. Doubts about the *Tirpitz*'s whereabouts arose, and it could not be confirmed that it was at Trondheim fjord; indeed intelligence reports indicated that the battleship was now at Bogen fjord.

It was at the beginning of October when the order to attack was given. The *Tirpitz* had been sighted at Bogen fjord and had now sailed south. Aboard

the *Arthur*, Sub Lieutenant Brewster, RNVR, Sergeant Craig, RE, Able Seaman Brown and Able Seaman Evans were the crews for the two chariots. The vessel encountered very rough weather in the North Sea, which casued a delay, then, at the pre-arranged location, the chariots were unlashed and made ready for the water, but the battery charging motor broke down. Sub Lieutenant Brewster decided that enough power remained in the batteries to cover the required distance. The chariots were now being towed behind the *Arthur*, which in late evening developed engine trouble, which meant the engine had to be stripped down. The crew was unperturbed; the repairs were made and the passage continued.

They passed the scrutiny of a German patrol boat and continued towards their target. But the weather began to worsen, causing the *Arthur* to rise and fall in the increasing waves, putting a great deal of strain on the towing wires. They steamed to a place of shelter where Evans was able to dive and examine the chariots. He followed the towing wires down to the shackles, but there were no chariots. Ironically they were within striking distance of the enemy target, the prized German battleship *Tirpitz*.

World War II-era midget submarines

In 1942, alongside the development of the human torpedo came a midget submarine called the X-Craft. The charioteers rode outside their craft and were subjected to hours in the bitterly cold water, although they wore protective waterproof suits and insulated undergarments. The new development meant that an attack could be made in the dry, with the craft being able to operate without exposing the crew to the elements.

X-Craft were 14.4 metres long and had a maximum diameter of some 1.68 metres. This meant the four men in the crew were unable to stand up straight, unless they were on the small side. The boat was divided into four compartments: the forward one contained the battery which supplied power for the ballast pumps and the auxiliary machinery, and powered the craft when it was submerged – it was also in this compartment that the divers' equipment was stored.

The second section was called the 'wet and dry' compartment. It was an escape chamber based on those designed and fitted in the latest submarines. Although the chamber was quite small, a man in diving dress could enter. The door of the compartment was sealed closed, and the diver opened a valve allowing water to enter. Once full of water, the outer hatch was opened and the diver could go outside. On re-entering the submarine, the diver would seal the outside door, then blow out the water until the compartment was dry. The inside door could then be opened, and the diver would be back inside the submarine. The use of this compartment did not alter the trim of the boat, nor did it allow water into the remainder of the compartments.

A World War II midget submarine. These were used in underwater covert operations in Europe and the Far East. They were towed by surface ships to the operational area when undertaking long distance missions, and the crew boarded the subs for the final attack. (Bettmann/Getty Images)

The third compartment was the main one and housed all of the controls for operating the submarine. Dozens of levers, wheels and gauges were crammed into the restricted space. The two periscopes were housed in this area, one giving a general wide field of view, the other narrow angled for attack. Also set in this overcrowded area were the air purifiers and cooking equipment, where the most basic of food and drinks could be made. The fourth and final compartment was the home of the gyro compass, the high pressure compressor and a further mass of pipes, gauges, levers and valves.

These small craft could remain submerged for 36 hours on battery power, and when cruising the crew operated in two shifts, two men at the controls and two men resting, changing round every four hours. On the run-in for attack, all four men would man their stations, one of them dressed in the diving equipment.

The main defences encountered by these craft were the anti-submarine and torpedo nets guarding harbour entrances. The submarine would move forward until stopped by the net. The diver would prepare to enter the water, and then by means of the wet and dry compartment he would exit the craft. Often these manoeuvres were carried out at night, and in the blackness he would move to the bow of the boat. Using heavy wire croppers he would begin the job of cutting the net, making a gap large enough for the boat to pass through. When he had made the hole, he would signal to the crew inside by a series of predetermined knocks on the hull, for the boat to ease ahead. The diver would check the clearance of the boat, ensuring that it did not foul itself. Once through, the boat would stop and the diver would re-enter it.

Members of the crew of a Royal Navy X-class midget submarine. One of the crew was a diver – a frogman who was able to leave and enter the submerged sub. One of the tasks for the diver was to cut nets that protected ports and ships; another was to place mines on an enemy ship. (Photo by Reuben Saidman/Popperfoto via Getty Images)

A harbour with some important ships at anchor may have had more than one net to penetrate, some of which could be breached by going underneath. Even when the outer defences were passed, the inner areas were patrolled by surface craft, aided by ASDIC and radar. The major ships were almost certainly themselves surrounded by protective nets. When the midget submarine reached its target it could either drop a large explosive charge underneath it, or the diver could go out again and place limpet mines on its underside, all of which, obviously, would be timed to detonate after the submarine had left the target area. The chances of the submarine finding the holes in the nets on the way out would be very small, so the diver might well have to leave the boat yet again to cut new holes.

After the initial unsuccessful raid by the human torpedoes on the *Tirpitz*, the X-Craft were presented with the target. The German vessel lay in the isolated fjord of Kaafjord in northern Norway. To reach the anchorage required the penetration of a minefield and a passage of 80km up the fjord. The journey was fraught with danger from shore defences and patrol craft. As the six midget submarines, X5–X10, entered the anchorage, they had to penetrate the anti-submarine and torpedo nets. One of the submarines had a compass failure and ran aground on an uncharted sand bank. It was spotted by an alert sentry and was subjected to a fierce counterattack by the enemy, using depth charges. The other five craft pressed home the attack, where charges were dropped below the ship. The submarines were scuttled as the crews escaped and were captured to become prisoners of war, and although the *Tirpitz* was not sunk, it suffered enough damage to keep it out of the war for some time. It also proved that the fjords of Norway were no longer safe for German ships from Allied underwater attackers.

The Germans were now wise to the threat and potential damage that could be caused by underwater attacks. They strengthened their defences with guards onshore and in patrol craft. Movable wooden platforms were built, which would be towed into place once a ship was moored, thus allowing the guards to walk round near the water's surface. They were armed with sub-machine guns and underwater anti-personnel charges. The attack divers soon overcame the new defences and would move into the harbour and wait submerged for ships to berth. Once the vessel stopped moving and was secure, the attack divers would move in and place their charges, to depart the target before the wooden platforms and guards were in place.

CHAPTER THREE

COMBINED OPERATIONS PILOTAGE PARTIES

In 1944 the specialist units of trained underwater swimmers were aware of the coming Allied invasion of Occupied Europe, and that the Germans were preparing heavy defences along the French coastline, not only on land but in the sea. Aerial reconnaissance had observed strange objects in the waters along the coastline. If a landing was to be made in the magnitude that a full-scale assault into Europe would require, then the obstructions would have to be removed.

Until this time the underwater swimming attacks had been conducted by small groups of highly trained men, but now the demand was for sufficient divers to clear the landing beaches and remove mines and bombs from the

A Royal Marine frogman dressed in his full equipment to be able to enter the water and survey the landing beaches and place charges on the obstacles to clear the way for the assault craft. (Photo by Keystone-France/ Gamma-Keystone via Getty Images)

harbours and ports as they were liberated. Apart from the manpower shortage, there was the need for more equipment, and each unit demanded different apparatus for the tasks that it would be called upon to undertake. The experiments at that time determined that the oxygen closed-circuit sets were safe in water up to 10m.

Combined Operations Pilotage Parties (COPP) was formed in 1942 by Commander Nigel Clogstoun-Willmott with the express purpose of beach reconnaissance. After a very successful survey prior to the Allied landings on Sicily, the unit was called upon to survey the landing beaches in Normandy. The first operation in January 1944 took the swimmers into the Gold and Juno beaches where, under the noses of the enemy, they undertook full beach surveys, collecting sand and soil samples and gathering data on the obstacles, all of which were festooned with explosives.

The second recce was to be of the Americans' Omaha and Utah beaches, and for this operation the divers used a converted X-Craft, which had some of the demolition equipment removed to allow additional navigation equipment to be added. Swimmers went ashore and gathered the valuable samples, which determined the make-up of each beach and thus its suitability to accommodate tanks and trucks; again the beaches were found to be well-defended by underwater obstructions.

From the information gained by these reconnaissance operations, mock-ups of the obstructions were made and experiments conducted to determine the best way of destroying them. Frogmen of the COPP, Landing Craft Obstruction Clearance Parties, X-Craft crews, two-man torpedo charioteers, limpeteers and the Boom Patrol Detachment trained and prepared for the operation, upon whose success would depend that of the initial landing.

Before the first signs of dawn on 6 June 1944 the surf broke heavily on the Normandy beaches. For the occupying forces in their concrete bunkers, it was just another day. To the observer gazing out to sea, only the dark gloom of night turning to day was evident. Below the concrete fortresses lay miles of barbed wire, mines, booby traps, tank traps, in fact anything that could obstruct a frontal assault. Had those watchers realized what waited in the darkness, they would not have been relaxed. Waiting offshore were X-Craft, rigged with coloured lights, and ready to act as markers to guide the landing craft into the safe lanes. Those midget submarines had been there for 48 hours.

The first men ashore on that memorable day were frogmen of the Landing Craft Obstruction Clearance Unit, who numbered some 120 men. During the hours of darkness they were taken by landing craft as close to the Gold and Juno beaches as possible, where they prepared their breathing apparatus and pre-shaped explosive charges. They knew that they would be subjected to pressure waves from explosions, which travel long distances underwater and could kill them. Specially designed jackets known as 'Kapok jackets' were therefore worn under their rubber suits. They were so successful that frogmen

close to an explosion survived blasts that killed unprotected troops in the water a considerable distance away, and it is without doubt these jackets, with their ability to absorb the shock waves, saved many of those swimmers.

Most of those men, preparing for the biggest strike frogmen would make against the enemy, were 'hostilities only' men. They came from quite ordinary backgrounds of civilian employment: bank clerks, carpenters, engineers, students and a cotton salesman provide an example of the mixed bag. They had all volunteered for 'special duties', not really knowing what they would be called upon to undertake, or where.

The final part of their journey was by inflatable rubber boats, which they paddled to the area off the beaches where the obstructions lay waiting for the invaders. Of the many obstructions that faced the divers, the biggest was the C-element which comprised 2 tons of 15cm steel girder work. Three metres high and three metres broad, it was a formidable barrier to the landing craft. The research experiments had found that it required 36 charges, strategically placed and detonated simultaneously, to collapse the structure to a height of around 45cm, thus allowing the flat-bottomed landing craft easy access over the top of them. The divers also had to deal with pyramid-shaped concrete obstructions called 'dragons' teeth', and steel girders joined together to form 'hedgehogs', both types of obstruction having mines fixed to them. Steel girders were also laid against fused shells, so that if a landing craft hit the girder, it would strike the cap and detonate the shell. All of these obstructions had to be removed.

The ten units of frogmen, four Royal Navy and six Royal Marines, left the rubber boats and swam to the obstructions. When they submerged, only the inflatable floats carrying the explosive charges were left on the surface. First they prepared lanes into the beaches, wide enough to allow the landing craft access, then moved either side to widen the lanes. The detonation of the charges levelling the obstructions announced their presence, and the enemy responded with mortar, artillery and machine-gun fire. The midget submarines were surfaced, and displayed lights seaward to mark out the landing lanes. As the first wave of troops stormed ashore, the frogmen were waiting for them.

By the end of D-Day, those 120 men had cleared a beach about 900m in length, and removed more than 2,500 obstacles, nearly every one of them mined. They stayed to assist in clearing the flotsam that remained after the landings: equipment and vehicles floundering in the sea, left behind as the war machine surged forward. At the end of the operation which had made the landings possible, they counted the cost: two frogmen dead and ten wounded, some seriously. A remarkable statistic, considering the nature of their operation. They did not consider themselves to be anything other than ordinary men, who had trained for a particular job which they had carried out with precision and faultless determination, regardless of personal sacrifice.

OPPOSITE
A frogman practises the skill of placing explosive charges to destroy beach obstacles prior to the D-Day amphibious landings. (Photo by The Enthusiast Network via Getty Images/Getty Images)

With the landings a success, ports were a top priority for capture, as the mass of stores and equipment needed to sustain the Allied army that now moved through France had to be landed at those ports along the northern French coastline. The enemy, in his efficiency, had mined the docks, harbours and locks. These had to be cleared, and the task fell to the COPP unit, who were effectively human minesweepers.

Because of the limited quantities of men and equipment pitted against the large area of harbours and docks to be cleared, it was apparent that an efficient and thorough search pattern would have to be developed. To ensure complete safety for ships, every square centimetre had to be covered. Ropes were laid in a box formation, with one movable rope tied to two opposing sides, thus forming a grid. The frogman would then position himself on one side of the rope and, holding it with one hand, he would move his free hand to its full extent, feeling in the mud. He would do this along the length of the rope, until he reached the other end. Another frogman would come towards him on the opposite side of the grid rope, sweeping the other side. They towed a thin rope with a float attached, which had two functions: first, those on the surface knew where the men were, and second, the divers could use the buoyed line as a marker when they found an object. When the two men reached their respective ends, they would push the grid rope along the box rope to the full extent of both arms, then move back along the grid rope, searching again. This time-consuming but effective method would be used wherever it was felt that a serious danger to shipping existed. Lock gates were booby-trapped, and barges and boats left by the enemy were likewise set to explode if moved. All had to be made safe. Once an area was searched and the finds marked, the searchers moved to the next area, while others of the party dived to recover or make safe the mass of shells, bombs and mines.

Those who had volunteered for the COPP needed to be qualified in the use of the free-swimming frogman equipment, but also needed to know what they had found in the slime and mud below the surface. Courses were organized for the men, who after an introduction in daylight, were subjected to crawling about with blindfolds on, identifying what they touched, for on the bottom of the docks and harbours they would be able to see nothing.

The first task for the COPP was with the US forces, whose task it was to secure the port of Cherbourg. This port was vital, as the first support vessels carrying men, materiel and fuel to the Allies would need to dock there and unload. As in the manner of all the underwater operations, it was completed, and the divers made some interesting finds in the way of new mines. Methods of dealing with them were found, and duly passed on to other units. Once a port was cleared, the particular unit involved would be sent forward to be with the advancing army, so that as soon as another port was captured, the divers could begin their search. Often they were subjected to artillery barrages while working, and more than one frogman must have wondered, as he submerged

looking up at his colleagues, in the see-saw motion of the fighting, which army he would look up at when he surfaced – his own or the enemy's!

With the end of the war in Europe, the task of clearing up began, and defence mines and booms had to be recovered. It was a dangerous job, for some of the explosives had been down for five or six years, and their condition was unknown. Great Yarmouth in Norfolk was one of many ports now encumbered by defensive mines which had to be recovered. The mines were cylindrical, with two buoyancy tanks, the latter used to aid their laying. The location of the pattern was close to the harbour entrance, in approximately 15 metres of water. During the laying, the connecting cable coiled on each mine unravelled upon lowering into place, and then the vessel moved to the next location.

To recover the mines, the recovery ship moved into location and dropped its anchor, using the tide to move back over the estimated location. The diver, using non-magnetic standard dress, then followed the shot line to the seabed and began a systematic search. Keeping the rope as near the seabed and as tight as possible he would move around in a large circle; if the rope fouled on anything, he would coil the rope up while following it to the obstruction. It was by this method that the first mine was found.

Each mine had a lifting line, which had to be found by the diver feeling into the mud. When he had done so, the vessel would send down a lifting wire for the diver to attach. Because the mine was partly buried, pulling on the wire could not release it from the suction created by the mud. To continue pulling would have parted the wire, or done more serious damage. The answer lay in the services of a fire boat, with its powerful fire-fighting pumps and hoses. Because the diver could never have held the hose, with its high water pressure, it was lowered down the wire to the mine, where the diver secured it by rope. Then the hose was secured to the wire at regular intervals. Pressure was applied to the hose, which supplied a powerful force of water washing out the mud. Tension was maintained on the wire, and when the mine broke free, the pumps were stopped. The mine and hose were recovered together. The remaining mines were easier to find, as they were joined by the interconnecting cable.

CHAPTER FOUR

FAR EAST OPERATIONS

In the winter of 1944 a large number of men from the US Navy Combat Demolition Units were sent to England to join the US forces preparing to invade the shores of Europe. The landings on the beaches of Utah and Omaha were to be headed by the demolition units, who did not anticipate any swimming, as the obstructions to be cleared were exposed at low tide.

When the landing craft neared Omaha beach, the enemy directed heavy fire against them. The severity of that fire left debris and wrecked craft, along with heavy casualties, to such an extent that some demolition units were wiped out altogether. Those who remained continued to set up their charges and cleared paths through the defences. The losses on Utah were 30 per cent, and on Omaha about 60–70 per cent. The survivors of this traumatic experience were then shipped to the Pacific, where beach reconnaissance and demolition were to be applied in support of future amphibious operations.

Missions of beach reconnaissance for the Americans became standardized after the landings in Europe and the major amphibious operations in the Pacific, and usually took place a number of days prior to a landing, which required the swimmers to remain unseen and unheard, so as not to compromise a possible landing area. With a beach chosen, the swimmers aboard a landing craft would head into the area and, amid a softening barrage of gunfire from ships and air strikes, the landing craft would run parallel to the beach, with a rubber boat slung outboard on the seaward side. The swimmers then moved into the rubber boat and rolled over the side into the water. In such a manner, a whole string of swimmers could be dropped off, unseen from the beach.

Swimming in to the beach, the men gathered all relevant information regarding water depth and any obstructions and then moved back out to sea. They would form a long line, with a space between each man, whereupon the landing craft would return and make a fast run down the extended line of bodies. A man in the rubber boat held a snare loop, and as the landing craft powered along the line of men, each swimmer held up an arm which was snared in the loop. The momentum of the boat heaved the swimmer out of the water and into the rubber boat, from where he would then move into the landing craft, leaving room for the next swimmer.

When hostilities ceased in Europe, the British specialist underwater warfare groups also turned their thoughts to the continuing war in the Far East. In the cooler northern waters, it was the numbing cold that was feared most. Hands and feet were always painfully cold, and neither woollen nor rubber gloves were satisfactory. Body temperature dropped, causing the diver to breathe faster, so reducing his endurance. To keep warm they wore all manner of undergarments, often to such an extent that it almost restricted their movements. On the plus side, the Protosorb chemical used to purify the expired oxygen operated efficiently, being cooled by the surrounding water.

The Far Eastern waters were to produce a reverse situation. High water temperature meant that the Protosorb could no longer be kept cool, and the result was sore mouths. The rubber suits worn in northern waters caused the body to overheat. They were discarded and the swimmers wore only swimming trunks with their diving sets, while face masks were replaced with goggles. As a result the frogmen swimmers became sick with ear infections and septic cuts on unprotected legs and arms.

The warm waters were the home for a multitude of creatures, which in those days were described more in horror comics than natural history books. The enemy they knew, the job they were to carry out they knew, but the sharks, octopuses, sea snakes and other unidentified creatures they did not. For these reasons, combined with the long distances often involved, free-swimming operations were limited, and craft came into their own, subjecting the frogmen to the dangerous waters for only limited periods.

Operations by swimmers and frogmen of the COPP, the SBS and other specialist units were numerous, and the attack on the Japanese cruiser *Takaeo* lying in the Johore Straits in July 1945 was typical. The craft used were the latest type of midget submarine, the XE. Operation *Struggle* comprised *XE 1* commanded by Lieutenant J. E. Smart, MBE, RNVR, and *XE 3* commanded by Lieutenant I. Fraser, DSC, RNVR.

They were towed to the operational area by the submarine *Stygian*. It had been decided that on this raid the explosive charges were to be fixed to the cruiser's hull by the frogmen, and not dropped onto the seabed. *XE 3* moved in and located the *Takaeo* in very shallow water. Moving alongside the heavy ship, Fraser eased the submarine underneath, until it became wedged between the 10,000-ton ship and the hard seabed. The 39-ton submarine was being squashed as the tide began to fall. Leading Seaman Magennis, the frogman aboard the craft, had dressed ready to set in place the explosive charge. Having flooded the escape chamber he found that he could only open the hatch a quarter of its normal distance. Using a closed-circuit breathing apparatus, he could not pass through with the counter lung bag expanded.

Magennis deflated the bag, which enabled him to squeeze through into the open sea. He made a survey of the ship's hull, and found it to be covered with barnacles and weeds. This would preclude the use of magnets to hold the mines

in place. Magennis returned to the submarine to collect a rope, which he used to lash the mines to the hull. It was exhausting work and he was barely able to close the hatch and drain the chamber when he re-entered the craft.

Fraser spent 50 minutes undertaking every possible manoeuvre to extricate the submarine, but to no avail. Then, without warning, it suddenly shot astern, and broke the surface. Fraser immediately flooded the tanks and bottomed the craft. He found that the vessel would not manoeuvre and it was decided that there was a problem on the outside. Magennis dressed in his underwater swim suit and breathing apparatus again, and on the outside he found that one of the mine containers had been damaged. After making repairs he returned into the submarine, allowing Fraser to steam the craft away to rendezvous with the parent submarine. Meanwhile *XE 1* had suffered a series of misfortunes which precluded its crew setting their charges. Fraser and Magennis were awarded the Victoria Cross for their exploits, and the result of the attack was that the bottom of the *Takaeo* was blown out.

On another occasion, in October 1945, the submarine HMS *Trenchant* moved in to make a reconnaissance of Pucet Harbour, a base for Japanese shipping. In the hours of darkness the submarine surfaced and two chariots were launched. The crews were given a final briefing and the target heading. They departed the boat and travelled on the surface, then partly submerged through the clear, calm water. Choosing a target the chariots dived and the commander steered his craft on a compass course to bring it under the hull of a large ship. Working quickly, the number two rigged the clips to the bilge keel, then fitted the explosive warhead.

Once the charge was in place they escaped, having to surface before they were clear because of a malfunction in a breathing set. They were unobserved and reached the waiting submarine. The other chariot had also been successful and had returned, and both crews and craft were secured. The submarine dived and moved to a location to watch the results of the raid. Some observed through the periscopes, while others felt the shock wave when it reached the boat. The textbook raid had been totally successful.

It will be seen from the preceding pages that for men to work underwater calls for a special quality, self-control and, if the need should arise, self-sacrifice. Man under the water is in an alien environment, but those men who carried the name frogmen had not only to learned how to use their equipment, but to improve it, and then write the operation manuals. Training was born from personal experience, and became severe even to the point of ruthlessness, but the end result was unquestionably the best that could be produced.

The frogmen came from a variety of backgrounds, and most had stable or even mundane jobs before being called for military service. They participated in experiments, gave their points of view, and from them came the two-man human torpedoes, the submersible canoe, the X-Craft midget submarine, and the much improved and developed diving dress and underwater breathing

equipment. Specialized parachute equipment for dropping equipment and craft into the sea was developed, as was the variety of high explosive charges, time-delay fuses and devices to prevent the removal of mines once in place. All were designed, produced and perfected so rapidly that, whereas the British were some seven years behind the Italians at the outset of the war, at the end they had not only caught up, but strode ahead to excel with the new fighting weapon, the free-swimming frogman.

Korea and Vietnam

In June 1950, the communists in the north of Korea, supported by the USSR and China, moved through the country to create a unified communist state. Those fighting the communists sought the aid of the West and the war soon found the United States and United Kingdom involved. In August 1950 a new British 41 Independent Commando was formed specifically for the war in Korea and was completely equipped by United States forces on its arrival in Japan.

The US Navy deployed Underwater Demolition Team combat divers to survey beaches during the Korean War prior to amphibious landings. They also carried out sabotage missions. (Photo by Underwood Archives/Getty Images)

America's strategy was to attack the enemy by amphibious landings, followed by a strike inland. A notable strike was at Inchon, where the Underwater Demolitions Teams (UDTs) charted the harbour, marking shallow water and underwater obstructions, and then undertook night-time demolition raids against amphibious and land targets. UDT divers also cleared mines from harbours and rivers. The British SBS, along with 41 Independent Commando, Royal Marines, undertook a number of strikes at enemy targets, often deep behind the enemy's front line. The SBS conducted sabotage and reconnaissance missions along the Korean coast, operating from submarines and warships. The inland targets included railway lines, tunnels, bridges and anything considered to be of military value, which were all blown up, damaging the North Korean lines of supply and communications.

Another notable amphibious landing was at Wonsan Harbour where the UDTs supported mine-clearing operations and acted as landing craft guides for the Marines' assault. It was UDT operator William Giannotti who conducted the first US UDT combat-diver operation using Self-Contained Underwater Breathing Apparatus (SCUBA) to dive and locate the sunken USS *Pledge*, where he marked its location for later demolition by surface-supplied hard hat divers to destroy classified information. The ship had been built as a minesweeper during World War II and played a part in the Korean War clearing mines but it struck a mine and was sunk.

For the duration of the war UDTs conducted beach and river reconnaissance, infiltrated guerrillas behind the lines from sea, and continued mine-location and clearance operations. But it was the Korean War that substantially changed the UDT operational role from predominately amphibious reconnaissance and mine/obstacle clearance to include covert infiltration from the sea, and to undertake raids and attack enemy shipping in ports and harbours as well as intelligence gathering.

Following the end of hostilities the UDTs back in the US were involved in a range of projects involving the development of breathing apparatus, the lock-out and lock-in of divers operating from submerged submarines, cold-weather diving, parachute training, and the development and testing of miniature submarines and swimmer delivery vehicles.

Following the Korean conflict there was a short lull in operational requirements for the UDT teams until 1955, when the US became involved in Vietnam. It began as an advisory role, but as the conflict evolved so did America's military commitment, until it was fully engaged. Like Korea, Vietnam had thousands of miles of beach which needed to be surveyed by divers. Two submarines, USS *Perch* and USS *Tunney*, were converted specifically to carry the diver teams and their equipment to the operational areas, and were kept busy with covert operations, being used by these divers in two different ways. One method was swimmer lock-out with the boat submerged, while the other was to surface the boat, bring rubber inflatables onto the sub's deck, then submerge,

A US naval diver from the Ordnance Disposal Team searching for underwater mines in Da Nang Harbour, Vietnam, 1970s. (Photo by US Navy/Interim Archives/ Getty Images)

allowing the teams to paddle the boats ashore. With the enemy's lack of radar in many areas, especially in the south, the submarines could surface with little fear of detection. The role of the UDT divers was unchanged from that of World War II when they had reconnoitred beaches and rivers, but they did gain a considerable amount of knowledge and experience.

Because of the geographical nature of Vietnam, with its vast waterways, it was seen to require a specialized amphibious force capable of undertaking covert operations independent of major commands. The result was the formation of the SEAL teams (standing for Sea-Air-Land) in 1962, after a personal directive from President Kennedy. The SEALs drew the majority of their members from the UDT. Having completed the basic UDT training, selected men continued with specialized training at the Army, Navy, Marine and Air Force special warfare schools. They learned the art of unconventional and guerrilla warfare, combined with waterborne clandestine operations, using free swimming and underwater delivery vehicles. Their tasks included, but were not confined to,

A badge for the US Navy Special Warfare Group – Vietnam. (Author's Collection)

the destruction of enemy shipping and harbour facilities, and conducting reconnaissance missions to gather vital intelligence. They were also able to train and assist friendly countries in counter-guerrilla operations, for which they had vital knowledge, being skilled guerrilla fighters themselves. Apart from direct combat or covert intelligence gathering, they provided medical aid and undertook elementary civil engineering projects in 'hearts and minds' operations.

The initial use of SEAL teams in Vietnam was to establish listening posts and ambush operations deep inside Vietcong-held territory. On these missions the SEAL units would usually insert and extract using small craft, which were heavily armed and armoured, and had a shallow-enough draft for access to the limited depth riverine areas. These first craft were later replaced by custom-designed high-speed craft, which were formed into Boat Support Units (BSUs). These, along with Mobile Support Teams (MSTs) and Navy Seawolf helicopters, combined to form a 'SEAL package', which meant that the small SEAL team inserted into enemy territory could call on rapid and effective support when required.

During 1967 the role of the SEAL teams was expanded, and the result was an increase in manpower. A large area of virtually impenetrable swamp and mangrove, named Rung Sat Special Zone, was another prime area of operation by the SEALs, where the teams carried out ambushes, established listening posts and undertook reconnaissance operations and diving. Members of one SEAL team captured a large quantity of Vietcong documents, translations of which showed that the enemy were using a number of freshwater wells in the Rung Sat area. In response, SEAL teams made several highly successful raids against these wells, thus denying the enemy a source of fresh water.

Listening posts set up on the waterways were often manned for seven days while the occupants gathered information about enemy movements, as they used the rivers as a prime means of transport. The teams would infiltrate and remain unobserved, with no outside support until withdrawn with their valuable knowledge.

The information gathered was amassed and charted so that SEAL teams using high-speed shallow draft boats could undertake raids and ambushes, accounting for many enemy killed and captured, along with quantities of equipment and valuable documents. In addition to the direct combat role, SEAL members also performed blasting jobs to open up rivers and waterways

to allow deeper penetration by naval craft. Their underwater skills were also put to good use in clearing rivers of obstacles, and removing objects from boats' propellers, as well as recovering equipment from downed aircraft. With greater manpower, the role, operations and subsequent results increased.

Reliable intelligence had determined that important members of the enemy's area political cadre were at a base on an island in the bay of Nha Trang. Lieutenant Joseph R. Kerrey and his SEAL team were tasked with capturing members of the cadre. Using small boats, the team reached the island unseen, where they had to scale a 107m sheer cliff, which placed them above the enemy camp, giving them a tactical advantage, and with luck an element of surprise. Lieutenant Kerrey briefed the team, which split into two groups before moving down a hazardous descent towards the enemy camp. They were successful in their advance, but close to the camp they came under heavy enemy fire. Kerrey was leading the group that came under fire and he caught the brunt of it. A grenade exploded in front of him, causing serious injuries, and leaving him bleeding heavily and in a great deal of pain. Even though seriously injured he directed his group's fire into the enemy camp, and with the radio man alongside him directed the other group's fire support into the enemy, which took the Vietcong by surprise.

Combat divers carried out underwater searches for crashed aircraft during the Vietnam War in an attempt to recover the aviators who died in the aircraft. (US Navy Combat Camera photo by Mass Communication Specialist 1st Class Blake Midnight / AB Forces News Collection / Alamy Stock Photo)

SEALs used small fast craft for patrolling the rivers to seek out the enemy, their vessels and bases to destroy them. Basic dive equipment was carried onboard for any underwater work. (CPA Media Pte Ltd / Alamy Stock Photo)

The SEALs won the fire fight, and even though Lieutenant Kerrey's wounds had immobilized him, he continued to command the team. Near unconsciousness, he ordered the defence and an extraction site to be prepared, and the prisoners guarded. The helicopters evacuated him, his team and the prisoners from what was a highly successful mission. Interrogation of the prisoners provided intelligence of untold value.

The South Vietnamese formed their own Navy SEALs, maintaining a close link to the US Navy SEALs and, in one example of a mission, Petty Officer Michael E. Thornton, USN, was the only American SEAL involved as US Naval adviser. The mission, in October 1972, was to gather information and capture enemy prisoners in an operation deep inside enemy territory. The team was transported aboard a Vietnamese Navy junk to a drop-off point, where they completed the last leg by paddling ashore in a rubber boat. On land they hid the boat and proceeded by foot towards their objective. During the move

they contacted the enemy, coming under heavy machine-gun and rifle fire from a large force of enemy troops. While the team engaged the enemy in a fierce fire fight, they also called for naval gunfire support. They directed the shells onto the enemy emplacements, causing a considerable number of enemy casualties. During the barrage they withdrew to the waterline, to prevent encirclement.

At the waterline the team took stock of the situation, and Thornton discovered that the senior officer had been hit by enemy fire and was believed to be dead. Not wanting to leave the man, if he were alive, in the hands of the enemy, Thornton dashed forward amidst enemy fire to the officer's last known position. During this action he was confronted by two enemy soldiers, who he disposed of. The senior officer was found to be unconscious and seriously wounded. With the enemy closing in on him, Thornton lifted the man onto his shoulders and carried him back to the waterline, where the only way of escape was into the water. He fitted and inflated the officer's lifejacket, and dragged him into the water, then towed him to safety where they remained for some two hours before the support craft found them.

SEAL team aggressive operations in Vietnam were focused more on land-based activities than underwater operations. They accounted for 580 confirmed kills, and in excess of 300 probable kills. SEAL Team One received two Presidential Unit Citations, and one Navy Unit Commendation. Its personnel received one Medal of Honor, two Navy Crosses, 42 Silver Stars, 402 Bronze Stars, two Legions of Merit, 352 Navy Commendation Medals and 51 Navy Achievement Medals. SEAL Team Two received the Presidential Unit Citation (Navy) for Extraordinary Heroism in conducting operations into the enemy's strongholds in the riverine environment of the Mekong Delta during the period 1969–71. The team accounted for large numbers of enemy casualties and enemy troops captured, along with weapons, ammunition and documents of immense intelligence value. As with Team One, individuals of Team Two were awarded a wide variety of awards for their part in the unit's operations. All of the awards are symbolic of the gallantry and courage demonstrated by the men of the SEAL teams in their ability to undertake raids requiring the skills, not only of amphibious operations, but also of clandestine 'on land' missions to strike against the Vietcong and North Vietnamese troops.

CHAPTER FIVE

SCANDINAVIA TARGETED

Sweden

The Soviet Union carried out subversive and aggressive submarine, mini-submarine and combat diver operations into the heart of Sweden's coastal defence zones, violating the country's territorial sovereignty, from the 1960s to the late 1980s. During the 1984–89 time frame, Swedish forces identified more than 600 detections of foreign intruders, against which they dropped depth charges, but failed to bring the contacts to the surface. Sweden's defence department determined that four categories of intruders had participated in the incursions: conventional submarines, mini-submarines, diver vehicles and combat divers – this was underwater warfare against a real enemy.

It was 27 September 1983 when a message arrived in the office of Sweden's Coastal Defence Group at Vaxholm stating that an observer at a defence station on Stockholm's northern sector had sighted unidentified combat divers on an island close to the station. Reaction was immediate: police, coastguard and military forces were alerted and ships and helicopters swiftly dispatched to the area. After a long search, however, they were unable to find any trace of the intruders, or of the submarine which must have brought them close to the coast.

The man who had spotted the divers was questioned intensively, for his evidence was crucial. He stated that he had travelled from his island home to the mine control station on another island, using a small boat. After landing, at about 10.30 on a fine, clear morning, he was making his way to his post when he saw something in the water, some distance off the beach. At first he thought it was a seal, for they are quite common in the Baltic. To get a better view, he climbed on to the roof of a building, and from this vantage point could see clearly that it was not a seal but a human. He then spotted a second diver in the sea, and finally a third diver crouched on the beach amidst some rocks – all of the individuals were in line.

In his testimony, he estimated that the furthest diver was about a hundred metres offshore, and said that the three men were roped together and only the diver on the beach could be described in any detail. He was dressed in a black diving suit and had two cylinders on his back, which were also black, and had two hoses going to his mouthpiece. The observer noted that the wind was

blowing, but it did not affect the movement of the divers in the sea, who remained in a straight line. When the diver on the beach saw that he was being observed, he moved without any sign of hurry, signalling to the others before entering the water. They all swam out to sea where, using their underwater breathing equipment, they disappeared below the water's surface.

The observer climbed down from the roof and started walking back towards the beach, at which point he watched as the three divers submerged and disappeared from view. To begin with, the observer thought the divers must be part of the Swedish Navy's 'Rangers', but when they failed to reappear he decided to put out an alarm. The man was questioned by SAPO, the Swedish security police, who are highly skilled in detecting lies or anomalies in witness statements, and they accepted his evidence as factual. He had been a serving officer since 1970 and was a trusted guard and reliable observer.

What concerned the authorities was what these divers were doing so close to the mine defence station – one of the posts from which the mines off the coast would be activated in time of war. The mines are laid on the bottom in strategic locations and linked together so that they can be detonated to have

In the 1980s, Sweden was on full alert for infiltrators from the sea who ventured ashore close to defence establishments. The troops searched for and engaged intruders, but never identified who they were; however, fingers were pointed at the USSR. (Bjorn Svensson / Alamy Stock Photo)

the most impact on a threat. The post in question is a particularly important one as it controls a channel leading into Stockholm harbour. The building itself is built of rock and concrete, and oversees a stretch of water which is freely used by merchant shipping, but in which diving is prohibited because of the possibility of one of the mines being detonated by accident. The channel floor is also laid with cables connecting the mines and with underwater sound detectors. The obvious conclusion drawn by the Swedish authorities was that the three divers were engaged in reconnoitring the inshore defences and using the rope connecting them to measure distances. This is just the sort of operation for which the then Soviet and now Russian Naval Spetsnaz units are specifically trained. (Chapter 9 covers the selection and training of combat divers.)

On Saturday 3 March 1984, there was an even more dramatic incident in which Swedish armed forces fired on unidentified divers, this time in the vicinity of Karlskrona naval base. The Swedish Navy had been hunting an elusive submarine for three weeks, and was on the alert for both a mini-sub and its parent submarine. As a result of the threat ground forces were also deployed, scouring the coastline with tracker dogs. Late on the Saturday evening a number of divers were spotted on the shore of Almö island and, after ascertaining that there were no Swedish divers in the area, permission was obtained to open fire. No casualties were observed and the divers disappeared beneath the waves without making any attempt to shoot back.

Undaunted, the 'enemy' divers did not retreat but were seen the following dawn, and the Swedish troops opened fire again but without seemingly hitting anyone. A search of the area uncovered food caches hidden in a nearby wood assumed to belong to Soviet intruders. Under threat, reinforcements were summoned and an intensive sweep made of the area. It was such a serious situation that, at one point, the army halted a funeral procession and, after checking the identity of each of the mourners, even insisted that the coffin be opened to check that there was not a diver inside! Despite this intensive search, no one was apprehended.

The Swedish military considered that the divers were from a midget submarine and divers were trying to lay up out of sight before making a rendezvous with their mother ship, a large submarine. The fact is that there were divers seen and engaged by Swedish troops before they disappeared without trace, and no submarine was physically discovered. Karlskrona is a natural target for Spetsnaz operatives because it is not only one of Sweden's major naval shipyards but also headquarters of the coastal artillery, which is responsible for the defence of Sweden's coastline.

As the events escalated, the Swedish authorities appeared to have been close to acquiring hard evidence of what was happening during late 1985, when three Swedish fishermen pulled in a net that had entangled and finally drowned a diver in restricted waters in the Stockholm archipelago. The fishermen, who had illegally laid their nets up against a local mine line,

panicked and dropped the net back into the water. By the time Swedish investigators arrived the body had gone, but a laboratory analysis revealed that the diver had been cut from the net with a knife or other sharp object, leading investigators to conclude that the body was that of a foreign diver who had been investigating the mine configuration.

Without doubt, the operations involving mini-submarines and the use of combat divers required a level of specialized underwater capability that at the time not many countries had in their armoury – nor did many have the inclination to carry out such operations – except the Soviet Union. With the focus being on the Soviets, their divers were considered to have been involved in minor acts of sabotage, ranging from the destruction of submarine nets and break-ins ashore, to the disruption and destruction of underwater mine lines. In 1983 Soviet divers are believed to have severed and carried away a mine that was part of the Furusund mine chain located in the northern Stockholm archipelago. Similar incidents were reported to have occurred in 1976 and in the later part of 1984. It was not possible to know the full extent or nature of Soviet activities in this area as Swedish authorities are themselves uncertain and would not want to discuss the attacks in any detail, but the evidence was that Sweden was under attack from a foreign power.

Why would Sweden be of such interest? During that time period, and even today, any Russian invasion of Norway, NATO's critical northern flank, would necessarily involve moving Russian troops across Sweden in order to consolidate ground. The objective would be to accomplish a virtual fait accompli before the West's quick reaction troops could be rushed into Norway. Moreover, the Kattegat is the Soviet Baltic Fleet's only access to Riga and Leningrad and exit to the North Sea, and is regularly patrolled by Swedish, Norwegian, Danish and German ASW (Anti-Submarine Warfare) vessels.

For about a ten-year period the Swedish Navy and Coastguard observed Soviet submarines inside Swedish territorial waters, discovered tracks made on the seabed by amphibious mini-submarines, and engaged with firepower divers apparently surveying beach approaches. All of these incidents have been thoroughly investigated by the Royal Swedish Navy, the Geological Survey Department, the Defence Material Board, and the Defence Research Institute, upon whose findings much of the evidence is based.

On 22 September 1982 the Press Department of the Swedish Defence Staff issued the following guardedly worded report which focused attention on the extent of the Soviet incursions, even though the USSR was not actually singled out as the 'aggressor' at this point:

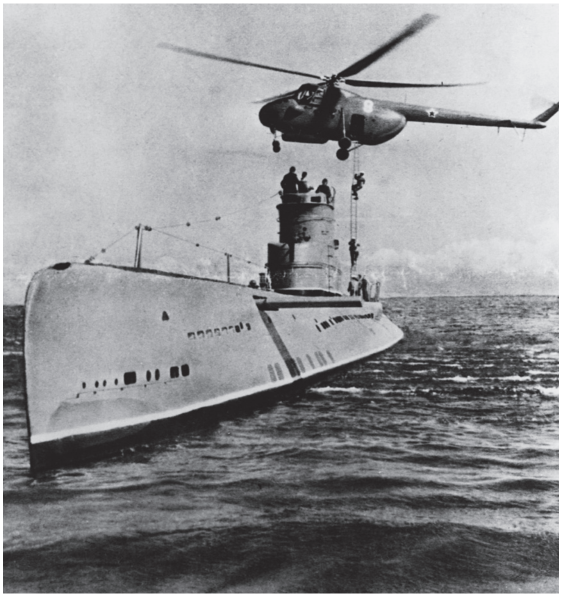
> Foreign submarines are difficult to discover and attack. In many cases, especially skilled personnel and qualified equipment will be demanded. Our resources for ASW actions, especially in peacetime, are rather limited.

> The ASW conditions in the Swedish eastern coastal area as well as in the western waters are totally different from those of the oceans, our waters being rather shallow, the bottom showing an utterly differing topography. Different water layers are at hand due to step-by-step variations in temperature, salinity and current at all depths. Depth and bottom conditions and the layers cause emitted sound waves to be reflected, dampened or give false reflections. In favourable conditions, a submarine may be detected at a distance of tens of kilometres while, under unfavourable conditions, the equivalent distance will often decrease to just a few hundred metres.

The 1982 summer had seen an unusual number of reports from military as well as non-Service sources concerning submarines. Every report has been thoroughly studied. About a hundred of them have been of a character to result in an interrogation of the reporting person and also in a subsequent expert's analysis.

In all, during the period more than 50 reports have been found to contain such facts as not to exclude the suspicion that they might stem from foreign submarines violating Swedish borders and trespassing on Swedish territory. This does not imply, however, that more than 50 single submarines have entered Swedish waters on a number of occasions, but rather indicates that a number of reports coincide in a way to further strengthen the probability of the presence of submarines. Ever since the summer of 1980, which saw considerable submarine activity in the Stockholm southern archipelago, a notable change in submarine behaviour has been noted. They then began to act a great deal more provocatively and were found to have penetrated even deeper into Swedish coastal waters.

Soviet naval personnel descend a rope ladder from a Mil Mi-4 Hound helicopter to the deck of a surfaced Soviet Whiskey-class submarine. The *S-363* then identified as the *U-137* ran aground in 1981 on a spying mission into Swedish waters. It was deemed to be carrying mini-submarines which infiltrated into Sweden's ports and coastline. (Photo © CORBIS/Corbis via Getty Images)



What brought violations of Swedish coastal waters to the public eye was when the Soviet Whiskey-class submarine *U-137* ran aground within a military restricted area in the Blekinge archipelago where the Karlskrona naval base is located. This incident occurred during Swedish Naval tests of a new wire-guided torpedo, and caused considerable embarrassment to the Soviet government. The Whiskey class of submarine was back in the 1980s virtually obsolete in the patrol and attack roles but, being diesel-electric propelled, is far quieter in operation than any nuclear-powered boat. Clandestine reconnaissance is thus a natural task to be entrusted to the remaining vessels in the Soviet fleet and extends their operational life.

Puzzled Swedish Naval investigators sought to inspect the interior of the submarine but were not allowed access to the vessel, although they were allowed to question its commander because there was the distinct presence of nuclear radioactivity in the water surrounding the boat. This seemed to indicate that the submarine was equipped with nuclear-tipped torpedoes and drew a strong protest from Prime Minister Thorbjörn Fälldin. Another anomaly noted at the time was the presence of attachment hardpoints behind the sail ('conning tower'). Hardpoints for what? The answer gradually emerged in that they were to secure a midget submarine for transportation.

The Swedish authorities determined that the submarines and divers were trespassing on Swedish territory with the following in mind:

> If a foreign power intends to have its submarines operate in Swedish waters in time of war or wants to keep an option for it, then the appropriate planning will call for basic information concerning suitable areas and other forms of information not generally found in navigational charts and descriptions.
>
> Of great interest is our defence preparations, especially so systems and installations within our ASW defence. It is no less important to obtain a general view on our anti-submarine warfare capacity. There might exist, too, a need for training in the Swedish archipelago waters, which are so unlike most other waters.
>
> A foreign power(s) may consider the submarine a suitable platform to either check on our military exercises and testing of new equipment or to deliver or retrieve personnel or equipment in coastal areas.

As the number of intrusions mounted, the Swedish government began to take a much harder line, and a Defence Staff memorandum of 20 September 1985 contains the following passage:

> One motive behind the submarine intrusions may obviously be intelligence gathering of Swedish defence preparations and exercises, including submarine defence activities. However, the repeated observations of large co-ordinated operations suggest that the task is not pure intelligence gathering. The Commission concludes that the submarine activities in Swedish waters must be seen primarily as preparations for actual missions to be undertaken in case of war. The exact nature of these preparations is not known, but a number of conceivable explanations have been presented. For example, they could be seen in connection with the wartime missions of covert mining and/or the landing of diversionary forces such as Spetsnaz for sabotage activities against crucial targets.

The Swedish naval base at Muskö, in Hårsfjården bay, is carved into the side of a mountain, and can accommodate both submarines and surface ships within deeply buried underground docks, protected by blast-resistant doors. Here, three Soviet Whiskey-class submarines, each acting as the mother ship for a mini-sub, were detected, but the Swedish Navy was unable to apprehend them. Subsequently, on 1 July 1983, the Navy introduced new regulations to allow its warships to force foreign submarines detected in Swedish waters to surface, 'if necessary with arms'.

The Defence Staff memo of 20 September 1985, referred to earlier, has this to say about the Muskö incident:

> The Submarine Defence Commission which as a result of this incursion was appointed to evaluate the incursions and the motives behind them, stated that during this period [October 1982] six foreign submarines may have operated in the Stockholm archipelago. Three of these were hitherto unknown 'midget submarines' with bottom-crawling capabilities. Two of the midget submarines together with a conventional submarine had penetrated the Hårsfjården naval base area, whereas the third midget submarine had actually intruded into Stockholm harbour. Prints found at the bottom point to the involvement of these submarines in the operations. Despite considerable resources used against the intruders at Hårsfjården, they proved insufficient and the submarines finally managed to escape. The Commission shares the conclusion drawn by experts that 'the violations were made by Soviet submarines'.

The mini-sub which entered Stockholm harbour was actually chased for a whole week before it succeeded in eluding its pursuers – a long time for a small vessel. The

The Swedish city of Karlskrona is home to the largest naval base with its five dry docks for the repair and maintenance of ships. Note that a military warship is in one of the dry docks. In the top right of the image behind the yellow building is a separate large dry dock. On numerous occasions, mini-subs have been used to infiltrate into the area on spying missions. (Andrius Kundrotas / EyeEm/ Getty Images)

Navy dropped depth charges over both the mini-sub and its mother ship when they refused to surface, but it is not known whether either was damaged. The submarines operating in Hårsfjården bay were also depth-charged, but again with indeterminable results. Later, similar midget submarine tracks were found on the seabed in the Oxelösund area, suggesting that the six vessels detected had been part of a much larger force.

Despite an intensification of its anti-submarine forces over recent years, the Swedish Navy has a particularly difficult task because of the hydrographic conditions off the Baltic coast referred to in the earlier report of September 1982. In the case of the Hårsfjården intrusion, the midget subs were able to operate in shallow water and in channels where the surface craft found it difficult to manoeuvre. The rugged coastline and numerous islands also helped screen the intruders from sonar – as they would also do in time of war. This has led to some speculation that the Russians may be reconnoitring safe anchorages in which their nuclear missile boats could hide, and this is certainly one possibility.

From reviewing the evidence, the indication was that the Soviets were using two types of midget submarine for their incursions, one of the tracked variety, and one a conventional floating design. The US Navy estimated that they were between 20 and 50 feet (9–15 metres) long, and carrying three to seven men. The tracked submarine was believed to have a single propeller so that it could swim as well as crawl. It was generally believed that the midget subs utilized a diesel engine and battery propulsion like any conventional submarine, the diesel being fed air through a snorkel to charge the batteries, and exhausting its fumes through the same system. They could have even be purely battery-driven, but the fact that one evidently survived for a week submerged while pursued by the Swedish Navy makes this unlikely. The batteries would not only have to provide propulsion but also operate the life support, lighting and heating systems, carbon dioxide scrubbers, etc. There was speculation that these craft were actually nuclear-powered, hence the radiation in the water.

A Swedish corvette moves at speed while engaged in anti-submarine operations with orders to fire on any intruders. (PAUL MADEJ/AFP via Getty Images)

Defending Sweden's many small islands, a fast attack craft operates in support of special forces including combat divers. (PONTUS LUNDAHL/AFP via Getty Images)

A *Financial Times* article on 14 November 2014 reports that a week-long search of the Stockholm archipelago by Sweden's Navy in October delivered a tangible outcome when it announced that analysis of a blurred photograph helped to confirm with the 'highest level' of certainty the presence of a foreign mini-submarine in Swedish territorial waters. There is no doubt that a small submarine violated Swedish territory.

The 'decisive' piece of information that identified the submarine was obtained by the armed forces as a result of 'highly skilled operational conduct', although no details could be disclosed because it would reveal military secrets, the armed forces said in a statement. In addition, an important photograph was taken by a member of the public and first circulated to the media on the third day of the hunt. Swedish media later established that the photo had been taken by 'Erik', 27, from his window. The armed forces said also they had '2nd and 3rd tier' observations from the public that formed a pattern, plus a sonar image of a submarine track on the seabed.

Then Agence France-Presse in Stockholm, on 27 July 2015, was quoted in *Defence News* with the headline – Swedish Divers Claim 'Russian Mini Sub' Discovery. Swedish wreck divers claimed to have discovered the wreck of a Russian mini-submarine in Swedish territorial waters, nine months after a high-profile hunt in Sweden for a mystery submarine. The Swedish military reacted with caution and wanted to see more images, which the (diving) company would send to them.

According to a diver from the Ocean X Team company that made the discovery:

> the vessel is 'completely intact' with 'no visible damage to the hull' and the hatches closed. It is unclear how old the submarine is and how long it has been laying at the sea floor, but the Cyrillic letters on the hull indicate that it is Russian.

The Ocean X Team said the vessel was around 20 metres long and 3.5 metres wide. The article states that, in October 2014, Sweden's navy launched a massive hunt for a foreign submarine, suspected to be Russian, in the Stockholm archipelago. The military subsequently confirmed that 'a mini-submarine' had violated its territorial waters, but was never able to establish the vessel's nationality.

Again, Agence France-Presse in Stockholm, on 26 October 2018, was quoted in the newspaper *Dagens Nyheter*, which reported that three teenage instructors and children at a sailing camp in the suburb of Lidingö spotted the mystery vessel on 28 June 2018. They observed for about 20 minutes what they believed to be a dark-grey or black submarine near the surface as it sailed away from where they were sailing dinghies. The teenagers took photographs and a short video of the object, which *Dagens Nyheter* published on its website.*

The public reports of suspicious activity resulted in the Swedish authorities declaring that a foreign submarine had been sighted no fewer than five times in Sweden's waters. One witness said he saw the sub inshore and a man in a black frogman suit close by. Speculation by submarine spotters suggested that it might have been an agent being landed or recovered, and that the boat was a new Russian 'stealth' coastal spy submarine. There was no mention of it being a mini-sub.

The Swedish military investigated, and concluded that they were confident of the measures they had taken, but could not comment on what measures were taken nor offer any conclusions. It would appear that the military did share the view that it was a foreign submarine, but refused to say if they had identified the object, or what it was.

Without a captured mini-submarine, or covert infiltrator frogmen/divers, there is no substantive evidence to point the finger at any one country, but for a long time someone has been giving their underwater covert operations unit(s) plenty of operational experience. The question as to who would gain from such covert activities would be the Soviet Union in the past, and Russian Spetsnaz units currently, but without concrete evidence we are left with just speculation.

All of the theories are plausible and possibly correct, and all are in keeping with the Spetsnaz doctrinal mission of special reconnaissance. The one vital matter that came from these incursions was that combat divers could operate in enemy waters from mini-subs with impunity. Even when hunted, attacked with depth charges, and shot at when on land, they continued their operations. The role of the underwater warrior has not been superseded.

* The video shows a craft, but at a distance, and it is not clear enough to make a determination as to what type of craft it is.

A Swedish patrol craft moving at speed. This could be used to carry combat divers and equipment to a target area, as well as to provide heavy weapons support during an operation. (Jan Hakan Dahlstrom/Getty Images)

Scandinavia, of course, encompasses a cultural region comprising Norway, Denmark, Sweden and Finland, with only Norway not a member of the EU, while Denmark is a member of the EU and NATO. Sweden and Finland are not members of NATO and not aligned, but in recent times have leaned towards NATO, being concerned following the unprovoked Russian invasion of Ukraine, a non-NATO country. Considering current affairs, it seems highly likely that incursions into Scandinavian waters by Russian combat divers and accompanying submarines are set to increase rather than decrease.

In 2020 the defence minister, Peter Hultqvist, identified that the Russians are willing to use military means to achieve political goals. With that in mind Sweden has a new geopolitical security situation to face, and there are now proposals to increase the military budget to 27.5bn Swedish kronor ($3.10bn) by 2025. Sweden relies on conscription for its armed forces and has proposed to double the number of people conscripted, with the aim of strengthening its defence amid the growing tensions with Russia. Sweden has hundreds of islands of varying sizes which have to be defended. At the time of writing, it is not militarily aligned as a member of NATO, but has close ties with the organization; however, Swedish commentators consider that the country has allowed its military forces to be run down following the end of the Cold War. That situation has allowed foreign incursions into their territory to occur under the sea, on the sea, in the air and on land.

During the late parts of the Cold War, the Coastal Rangers were used mainly as a very highly trained commando unit, whose main tasks were to carry out amphibious landings for raids and assaults, particularly in defence of the country's many islands. An enemy taking control of any of Sweden's islands would have the basis of a foothold in the country, so the specialist unit would undertake long-range reconnaissance, sabotage operations, or direct action depending on the opposition. To undertake their role they are experts in all water areas, such as the coast, rivers and lakes.

Part of the Swedish defence force, the Coastal Rangers are an amphibious special operations unit comprising an undisclosed number of full-time professional service personnel. They are tasked with undertaking reconnaissance patrols behind enemy lines, while still retaining the capability to conduct direct-action missions. To be accepted onto the very demanding 12-month basic Coastal Ranger course the volunteer must already be a serving member of the Swedish armed forces, and have at least one year's service, or have completed conscription. Not everybody is called for military service so the main reliance is on those who elect for a full-time military option. Those who wish to volunteer for the Coastal Rangers can be from any branch of the military, and the course is open to both sexes. Every volunteer must meet the same standards, and in 2021 one woman was actively progressing through the selection process.

Individuals who are successful and are selected for the Coastal Rangers will join either the commando or reconnaissance elements, where they get their specialized training. The commandos operate with four to eight members in every team, and the different specializations include those who will lead and the second-in-command. There are communications specialists, medics, demolition experts, sniper/spotter, and where appropriate, support weapons.

Until 1994, the green beret was exclusive to the Coastal Rangers and was awarded for successfully completing the course, along with the trident cap badge, but the green beret is now worn by everybody who is attached to the amphibious battalion.

The Coastal Rangers are divided into two elements: the assault/commando element, and the frogmen reconnaissance element referred to as *attackdykarna*. While both elements are experts in deep reconnaissance and direct action, the commando element is more orientated to direct action than the frogmen, who will often be more covert in their activities. The reconnaissance frogman element is highly skilled in conducting underwater insertions, which makes them the prime element for certain missions.

The elite Swedish combat diver platoon is found within the Coastal Ranger unit, which is a component of the 2nd Amphibious Battalion, based in Stockholm. The combat diver teams are tasked with gathering intelligence behind enemy lines and conducting sabotage operations against high-level targets. A dive team comprises a small unit with the capability to operate independently for weeks, carrying out its mission.

OPPOSITE TOP
The Rangers are skilled in moving across the land and expert at skiing, allowing flexibility on operations. (Photo by JONATHAN NACKSTRAND/AFP via Getty Images)

OPPOSITE BOTTOM
Surviving and operating in the sub-arctic allows the Rangers to live and fight in a tough environment, either on reconnaissance or on missions behind the enemy lines. (Photo by JONATHAN NACKSTRAND/AFP via Getty Images)

ABOVE
A Swedish Coastal Ranger with 1st Marine Regiment with a Swedish Automatkarbin 5 service rifle at Harsfjarden, Sweden in 2018. (Bob Collet / Alamy Stock Photo)

RIGHT
Swedish combat divers are deployed from a small craft to carry out underwater searches and the inspection of underwater cables and defence mines. (dpa picture alliance archive / Alamy Stock Photo)

Having passed the Coastal Ranger course the prospective candidates must then pass a certain number of mental and physical requirements, including a suitability test to verify the volunteers' underwater capability and ability to endure cold water. Those who pass the suitability test may then be admitted to start the 16-week combat diver course. The combat diver platoon requires the personnel to be able to work in small teams, with the requirement to operate with a high degree of precision, often under uncomfortable conditions.

ABOVE
Swedish special forces combat divers are deployed in defending the country and its many islands in the event of hostilities and operate against any aggressors. (Jan Hakan Dahlstrom/Getty Images)

LEFT
Swedish special forces deployed in a high-speed craft operating against foreign infiltrators along the coastline. (PAUL MADEJ/ AFP via Getty Images)

The divers use the Swedish Oxydive rebreather apparatus, which is a closed-circuit system using 100 per cent oxygen, which allows underwater movement with the complete elimination of expelled bubbles, making the teams' infiltrations totally concealed. The unit also has the ability to conduct operations at deeper depths by using a nitrox-configuration.

Because of the platoon's operational area they use a variety of combat boats and inflatable craft to reach a deployment location for surface or underwater swims. The craft could also deliver them to the shore if necessary.

The platoon's typical choices of weapons are: the HK G36 C2 carbine; FN Minimi – which is a Belgian 5.56mm Squad Automatic Weapon; Glock 17 – 9mm semi-automatic pistol; and the L96A1 AW (PSG 90) – which is the Swedish adopted version of the British L96A1, or Arctic Warfare (AW). There are a few differences in the two rifles, such as the AW rifle having grooves on the bolt to help improve reliability in the snow, a specific Swedish request.

The Coastal Rangers combat divers are an elite within an elite and will be a key element in a country endowed with numerous lakes and thousands of islands off a long coastline, and which is close to a potential enemy who is the cause of unwanted incursions.

Norway

Norway has long been of interest to the Russian military as it provides a NATO land border with the ability to observe the Northern Fleet's warship movements in the Barents Sea and, like Sweden, the Norwegians have chased unidentified submarines and mini-subs but have not been able to obtain the definitive evidence of the intruder's identity. Similarly, there have been incidents involving Norway's cables on the seabed, and with Russia's focus on undersea communications there is obvious speculation in the media as to the perpetrators of damage.

The Lofoten-Vesterålen (LoVe) Ocean observatory is an underwater observatory located off the coast of northern Norway which was damaged in November 2021 when more than 4.3 kilometres of its offshore fibre-optic and electric cables were cut and then removed. The resulting investigation discovered that the information-gathering pods the cables were connected to were dragged off location. The newspaper *Dagens Næringsliv* reported that the

Northern Norway provides a target for enemy infiltration by submarines and combat divers. It is a hostile and sparsely populated environment, which borders Russia. As Norway is a member of NATO, there is considerable cooperation with combat divers of other countries. (Photo by Robert Nickelsberg/Getty Images)

LEFT
Undersea cables are a lifeline for Norway as they carry power and communications from the mainland to the many islands. If the cables are cut, the infrastructure is put at risk. (Photo by Keystone Features/Getty Images)

ABOVE
Longyearbyen on Spitsbergen Island, in Norway's Svalbard archipelago, is where the SvalSat global communications centre is located. Comprising more than 100 satellite antennas, it forms the world's largest commercial ground station, with worldwide customers, and needs the internet to operate. (Photo by: Eye Ubiquitous/Universal Images Group via Getty Images)

trouble began earlier in the year when screens in the observatory's control room suddenly went blank and data gathered from the surveillance network of cables that extend for 66 kilometres into the Norwegian Sea stopped flowing.

The pods' primary purpose is to monitor fish movements and the condition of the sea for any pollutants, noise or other abnormality, but they can also monitor submarine movements and so the data gathered is shared with the military. The pods are located in deeper water, making them inaccessible to divers, but they are not immune to ships' anchors or fishing trawls; however, any vessels in the area would be identified and recorded by the authorities. Ships in the area that had their tracking systems activated during a six-hour period on 3 April when the damage is believed to have occurred have been identified. Those who turned their tracker off are impossible to identify and *Dagens Næringsliv* reported that there was much Russian shipping activity in

A2
RANGER

the area. The fact that the Norwegian defence authorities had access to the data means that it could have easily been a spy/sabotage operation.

There followed a second cable incident when a fibre-optic cable between mainland Norway and the island of Spitsbergen went off-line. The *Barents Observer*, located in northern Norway, identified that on 9 January 2022 a fibre-optic cable linking Longyearbyen on Spitsbergen Island, in Norway's Svalbard archipelago, stopped working. The Svalbard Undersea Cable System is a seabed fibre-optic communication cable connecting Longyearbyen Arctic archipelago with Andøya, north of Harstad, in mainland Norway. The cable serves the local community as well as the SvalSat global communications centre; comprising more than 100 satellite antennae, it forms the world's largest commercial ground station, with worldwide customers. Investigators have determined that this incident had human input, but on a positive note there is a second cable that is still functioning, although it is being overloaded, and the SvalSat centre is reliant on the internet. While it might be an anchor or fishing trawl, no surface vessels have so far been identified, while Russian submarines and mini-subs are known to venture into Norway's territorial waters, with one example involving the west side of the Jarfjorden in northern Norway close to the Russian border at the small bay of Skipshavn. Apart from a few holiday cabins the remote location is deserted, but a man local to the area dives for crabs in the cold, clear water, and on one dive he made a remarkable discovery which has been kept secret by the Norwegian government for 30 years.

OPPOSITE
Norwegian combat divers work with those from other countries who gain experience of diving in extreme cold conditions. (US Navy photo by Mass Communication Specialist 2nd Class Mark Andrew Hays/Released)

BELOW
Norwegian special forces divers can exploit the underwater but also have to operate on land in extreme conditions while undertaking observations, reconnaissance or fighting missions. (Photo by Robert Nickelsberg/Getty Images)

In 1989, Tore Lasse Moen was an intelligence officer for the Marine Hunter Command, and led the investigation into the reported findings. Following several dives at a depth of between ten and 20 metres, he found on the seabed long, straight and parallel lines which he measured to be about five centimetres deep. Two days later minesweepers and a diving ship arrived at Skipshavn and began to search the area, where the military divers located and photographed eight suspicious tracks. While they were determined to be man-made, the investigations concluded that they were not new. With nothing else found the operation was suspended for a period of time, and when the divers returned to continue searching they discovered new tracks which were considered to be only a few days old. The military actioned two four-man teams of Norway's naval special forces who are skilled in covert observation missions to be deployed to Jarfjorden and the whole operation was kept secret even within the Defence Department.

An observation hide was established in this rather sparse landscape, on a headland among the rocks and bushes located on the other side of the Jarfjord bay close to the entrance to Skipshavn. The teams worked in shifts while exposed to the elements that can in winter see heavy snow and temperatures as low as -40 degrees.

About a month after the observation post was established the operatives observing the water were alerted to a movement where the surface was broken. The object was about eight metres long and was moving towards land, remaining visible for up to five minutes before disappearing below the surface. The operatives reported in a debrief that the unidentified vessel was rounded at both ends, with large pontoons on the sides, and there were reportedly detailed sketches produced of what was observed. The drawings corresponded with several types of mini-submarines that the Soviet Union had operational at the time. The operatives also described a repeated series of flashing lights from the inlet to the Jarfjord, and these were considered to be from a support ship that often follows mini-subs. However, there is no mention of any surface ships in the area, so it could indicate that a mother submarine was in support as had been the case in Sweden.

Based on the sightings, the operatives were moved across the fjord to a harbour where they established a new observation hide which was close to the water and provided a good view of the area of interest. From this location an observer heard a noise in the sea and then spotted bubbles breaking the surface, followed by a vessel the same as identified previously. An attempt to photograph the vessel was made, but the camera failed to work correctly because, it is claimed, of the extreme cold. Following this sighting divers were deployed and found new tracks on the seabed which then confirmed the presence of a mini-sub with the ability to crawl along the seabed which was considered to be of Soviet origin.*

* Information drawn from a translation: http://gyllenhaals.blogspot.com/2017/10/sovjetiska-krankningar-ryska-roster.html

The Norwegians have reported other instances of unidentified submarine and mini-sub activity where they resorted to dropping depth charges to bring the vessels to surface but, as in Sweden, they were unsuccessful.

Finland

Finland borders Sweden, Russia and Norway in the very north, with the majority of its coastline facing Sweden and Europe to the south, and has a 1,300km land border with Russia. The country is militarily unaligned and has not at the time of writing joined NATO, but has joined the NATO Response Force, the EU Battlegroup, and has signed a NATO memorandum of understanding, thus forming a practical coalition. Their military is structured for defence purposes and offers no threat to Russia, but with the situation in Ukraine the country is considering its options, especially after Russia has threatened that if it was to join NATO it would suffer the consequences, and there was even talk of nuclear war.

Finland is one of a few countries that relies on a conscription military, which is a cost-effective way of generating a large and capable reserve with which to defend the country. In Finland's constitution every Finnish citizen is required to participate in national defence, and so every male aged 18 to 60 is liable for military service, and women can apply for military service on a voluntary basis on the same terms as their male counterparts. With every male liable for service there is the option to serve in either armed or unarmed military or non-military (civil) service.

ABOVE LEFT
The Finnish coastline comprises a rocky shoreline and forested hinterland, both on the mainland and on the islands, which would enable enemy activities. This requires the defenders to be able to act covertly and quickly. (Tuomas A. Lehtinen/ Getty Images)

ABOVE
Two Finnish combat divers enter the water wearing SCUBA diving equipment. The divers have to be able to operate in cold water, as it will test the resolve of the divers themselves and their equipment. (Vladimir Fedorov / Alamy Stock Photo)

The basic training takes place during the first eight weeks, followed by any specialty training, which has an impact in terms of length of service. All conscripts embark on their military service as equals in every respect, which is based on the concept that anybody can perform well in the military regardless of their background. Depending on any specialization that the individual elects to undertake, the length of service they will do varies from 165 to 255 to 347 days. Following the formal military service the individuals depart to be in a reserve unit until they reach the age of 50 (60 for officers and NCOs) in which time there will be refresher training commitments. While actually serving, all conscripts are accommodated, fed, clothed and provided with health care, and they receive an allowance depending on their individual circumstances and time they have served. In addition to the basic allowance, those serving as parachutists or divers receive extra payments.

Those opting for diver training serve for 347 days, where they undergo the tough training of the naval special operations forces of which some 20 will qualify in both the two rotating specializations, combat divers and EOD divers. The system means that the divers rotate every second year, as combat divers in even years and as EOD divers in uneven years. Combat divers conduct maritime reconnaissance and covert missions in the challenging conditions of the islands and coastal environment and EOD divers are trained to operate in search and defusing missions of underwater explosives. All divers are taught air diving as well as rebreather use for combat diving, and mixed-gas equipment for EOD operations.

In 2021 Finland moved to consolidate all of its Special Operations Forces into the Utti Jaeger Regiment to unify the various elements of special forces, which means that the Naval Special Operations Detachment, operating currently under the Navy's Coastal Brigade, transferred to the Utti Jaeger Regiment. It is the Coastal Brigade that trains combat divers for special operations tasks, and with the specialist elements centred in the single unit there will be a unified approach to operations on land, on and under the water, and helicopter integration. The Finish special forces are open to both men and women, but they have to commit to serve a minimum of 12 months of their compulsory conscription.

OPPOSITE TOP
Finland operates a conscription system for military service. During this period, those who volunteer can seek to join the combat divers, whose selection and training is the same as that of other countries' combat diver units. There appears to be no shortage of volunteers. (Hannu Mononen / Alamy Stock Photo)

OPPOSITE BOTTOM
Combat diving is a means to an end which can include reconnaissance and direct action against enemy targets, and so divers are conditioned for winter warfare and weapon skills. (David Wa / Alamy Stock Photo)

CHAPTER SIX

SPECIAL FORCES DIVER UNITS

By the very number, complexity and secrecy of special forces diver units only a sample of such units are included in this book – from the largest, to some of the smaller but no less important. Not every country contacted was prepared to provide information, so it became a situation of focussing on those who provided support. Naturally, some units have more representation because they provided more information. Everything about special forces (SF) divers is secret, especially information about individual units, their size and composition – such is their importance within military structures. The US Navy SEALs are the most open of the units and possibly comprise the largest of the SF diver formations, but while some information is available about Russia's Spetsnaz there is no accurate figure as to the numbers in their formations. From the Dutch Marines Special Forces frogmen, to Singapore, around the world specialist divers go about quietly protecting their country's maritime sector.

The one thing that is evident with all special forces diver units is that the individuals, having already undertaken the toughest selection and training process within the military, then undergo further selection and training, also tough and demanding, to be able to enter the world of underwater warfare.

Combat Dive Mission off East Timor

Able Seaman Clearance Diver Justin James Brown was a member of Australia's Clearance Diving Team (CDT) 4 during the team's 1999 deployment to East Timor for Operation *Warden*. On the night of 21 October 1999 CDT 4 was tasked with a clandestine reconnaissance in advance of an amphibious landing by Australian troops into the Oecussi Enclave in West Timor.

As part of a diver reconnaissance pair, Able Seaman Brown was tasked with gathering beach intelligence for the proposed landing site. His mission was to select the most suitable beach for the landing planned for the next morning. In addition, he was tasked to provide surface protection and early warning of impending danger, working close inshore, and for the submerged dive

team. During the reconnaissance a number of shots and explosions were heard coming from the nearby town centre, while two vehicles proceeded along the beach conducting a search to seaward using high intensity lights.

During the period of greatest threat from compromise, Able Seaman Brown jeopardized his own safety by remaining close to the shore to provide support to his commanding officer and the dive team. His actions in remaining in place without being compromised showed great personal courage, and in recognition of his deeds he was awarded a Commendation for Gallantry.

The United States

Three main US military organisations have large numbers of combat diver personnel; however, there are other US military units that also have personnel trained as combat divers and generally undertake their qualifying with the larger units. As with combat diver units around the world, secrecy is key when it comes to actual operational matters, and as explained by Lino Miani, President of the Combat Diver Foundation (USA): 'Classification of their operations may become an impediment [when seeking information].'

One main reason for there being so little operational information is that their combat diver missions and methods are ultra-secret, and details of operations could adversely effect their ability to operate effectively.

In the words of the US Senate Armed Services Committee, some of the least-known special operations missions are authorized under a provision known as 'Section 1202 Authority', which first appeared in the 2018 National Defense Authorisation Act (NDAA), and is 'used to provide support to foreign forces, irregular forces, groups or individuals' taking part in irregular warfare. Neither the Defense Department, SOCOM (US Special Operations Command), nor any media outlet has ever revealed detailed information about 1202 missions. What little is known is that they are focused on China and Russia or, as former Secretary of Defense Mark Esper put it, 'non-terrorist threats, including malign state actors.'*

According to an unclassified summary of the Irregular Warfare Annex to National Defence Strategy 2020, 'China, Russia, and Iran are "practitioners of campaigns of disinformation, deception, sabotage, and economic coercion, as well as proxy, guerrilla, and covert operations."'

In an article in *The Atlantic*, dated 12 March 2021, acclaimed journalist Mark Bowden wrote:

> Within the span of a few decades, the United States has utterly transformed its military, or at least the military that is actively fighting.

* https://www.armed-services.senate.gov/imo/media/doc/Esper_APQs_07-16-19.pdf

> This has taken place with little fanfare and little public scrutiny… Special Ops is lodged today under the Special Operations Command, or SOCOM, a 'combatant command' that reports directly to the Secretary of Defense. It has acquired its central role despite initially stiff resistance from the conventional military branches, and without most of us [the public] even noticing… It happened out of necessity. We now live in an open-ended world of 'competition short of conflict,' to use a phrase from military doctrine… Made up of elite soldiers pulled from each of the main military branches – Navy SEALs, the Army's Delta Force and Green Berets, Air Force Combat Controllers, Marine Raiders – it is active [2021] in more than 80 countries and has swelled to a force of 75,000, including civilian contractors.

The outcome is that most of SOCOM's action takes place in secret and can include any of the units within its command, which, in global terms, means that there can be an immediate response.

Although the SEAL Teams' missions might be different to those of other US special-forces combat diver units, the basic diver training is not. SEALs, Marines and the Army SF have their own dedicated training facilities, but they all have very similar curriculums and they all fall under SOCOM. However, the Navy sets the standard for all combat diver training through approving and monitoring tasks being taught at each diver centre.

Whichever route is followed, the selection and course will be extreme, with a high attrition rate, so being an elite diver is not an easy option. Some military commentators are expressing the view that those undertaking combat diving courses since 9/11 are finding it harder, especially the pool activities where instructors are pushing the limits. The US Navy says that in 1999, about one out of every three students actually became SEALs, while now only one in five make it through the course. The US Navy reports that 200 to 250 SEALs a year graduate, leaving more trainees failing, even though larger numbers of sailors attempt the course.

In addition, there is something that sets apart the Special Forces combat diver from the standard Green Beret, and this is explained by Sergeant Major Roberto Oquendo, company sergeant major and the senior enlisted advisor to the commander:

> What truly sets apart the Special Forces combat diver from the already elite Special Forces Soldier is determination and drive to be better than everyone else… It's that determination, that drive that they're always looking to be better, better than everybody else. You hear it in Special Forces and around Rangers. And you can probably find a consensus about the CDQC course as one of the hardest – mentally and physically demanding – in the Army.

The US Navy is the largest in the world and operates in a global capacity, and it follows that it has the largest combat diver force, undertaking roles from reconnaissance and infiltration for land operations, to carrying out limpet mine attacks on enemy shipping. They have special purpose submarines to deploy from, as well as mini-subs and swimmer delivery vehicles supporting them, allowing them to be a highly secret covert maritime force. Unlike other special forces units, all qualified SEALs are combat divers.

The US Marines have the largest amphibious landing capability to operate anywhere in the world and part of that operating capability is that its combat divers are able to carry out covert infiltrations, surveillance and information gathering as a rapid response. They could also operate overtly and surface swim to get ashore and engage a target.

The US Army 'Green Berets' Special Forces train their own combat divers as an optional specialisation and, even having passed the SF selection and with some operational experience gained, some operators do not make the grade in the aquatic environment required for being under the water. Having combat divers provides the SF with a broader operational capability where covert missions involve water insertion.

US Navy SEALs

From within the massive military armoury of the United States of America comes a formidable underwater diving force, originally divided by its objectives into distinctive units, each highly specialized. These were the original Underwater Demolition Teams (UDTs) and the Sea-Air-Land teams (SEALs). There was a reorganization programme initiated in 1983 when all Naval Special Warfare divers were formed into SEAL teams. The name SEAL refers to their versatility in operating by sea, air and land.

Within the US Navy there are two Naval Special Warfare Groups which come under the control of the United States Naval Special Warfare Command (NSW), which itself comes under the Special Operations Command (SOCOM) umbrella. NAVSPECWARGRU ONE is based in Coronado, California, and NAVSPECWARGRU TWO in Little Creek, Virginia.

There are eight SEAL teams (1, 2, 3, 4, 5, 7, 8 and 10) and each team is composed of a Staff Head Quarters element and three 40-man Task Units, comprising a headquarters element and two SEAL Platoons of 16 men, which are the primary fighting element of the SEAL teams. There is also a combat support staff made up of Administrative Support, Intelligence, Operations, Logistics, Plans and Targeting, and Air/Medical.

In addition to the SEAL fighting teams there are SEAL Delivery Vehicle teams who operate a fleet of mini-subs and swimmer delivery vehicles used for covert underwater operations. They use the vehicles to transport divers to clandestine operations, such as underwater insertion and extraction of teams who might be placing magnetic limpet mines or other explosives to berthed

NEXT PAGES
US Navy SEALs come ashore having been deployed into the water out at sea. This has involved a surface swim rather than using underwater breathing apparatus. (Photo by Richard Schoenberg/ Corbis via Getty Images)

NSWC

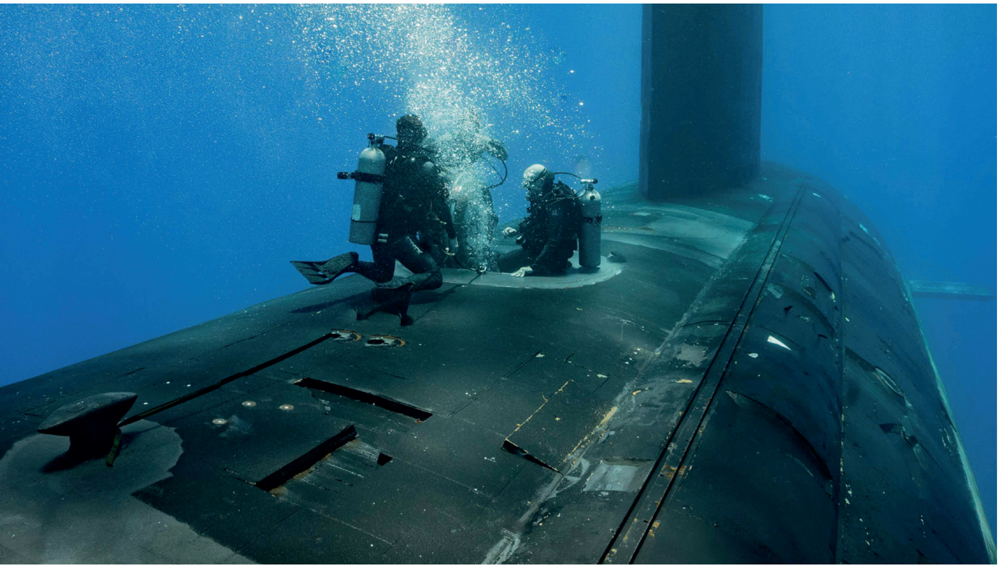
shipping, or undertaking underwater reconnaissance, or making a clandestine approach for maritime counterterrorism. The SEAL Delivery Vehicle team is formed of two platoons of 16 men, each composed of 11 SEALs, one dive medical technician and four fleet support maintenance technicians.

The SEALs Special Boat Squadron's function is to conduct coastal and riverine insertion and extraction operations for SEAL teams, as well as to provide support for them when required. They have a variety of surface craft at their disposal, which will be selected and used depending on the circumstances. They can drop off and pick up the divers of operational teams during their beach surveys and reconnaissance missions, and they can also provide fire support vessels and specialized craft required by the SEAL team's covert operations.

The US Naval special operations forces do not have a defined set of tasks or roles, but are a flexible operational arm of the Navy's fleets. It is the approach to a target, either on the water's surface or below it, that distinguishes them from those of other arms such as Marines or Army, but whereas water is the cornerstone of their speciality, they also have the ability to operate inland.

ABOVE
A SEAL moves ashore following an underwater swim. With weapon ready, he keeps his dive equipment in place in case he has to make a rapid withdrawal. (US Navy photo by Mass Communication Specialist 1st Class Eric Chan)

RIGHT
Extracting from the beach requires the divers to see what is happening behind them and have weapons ready to defend themselves with while making a fast exit to get underwater. (US Marine Corps photo by Cpl Matthew Manning/Released)



TOP LEFT
Countries with submarines will have a system for deploying combat divers to targets by enabling a diver transfer while remaining submerged. This image shows the divers using a hatch into a chamber to exit and enter, while others use the torpedo tubes. (US Navy photo by Mass Communication Specialist 2nd Class Alex Perlman/ Released)

LEFT
A submarine fitted with a dry deck shelter (DDS) in which a swimmer delivery vehicle (SDV) is carried. (US Navy photo by Mass Communication Specialist 1st Class Ashley Berumen/ Released)

The SEALs have been heavily involved in the Iraq and Afghanistan conflicts, which have been land warfare, but as those commitments are reduced the emphasis is returning to their underwater roots. The new mini-subs and SEAL Delivery Vehicles, as well as the modified submarines added to their armoury, are an indication of just how important combat divers are in war planning.

Reportedly SEAL Team Six was disbanded in 1987 and many of the team formed a new team called the Naval Special Warfare Development Group, (DEVGRU), but in public it is referred to as SEAL Team Six. It is the United States Navy component of the Joint Special Operations Command (JSOC) and is often referred to within JSOC as Task Force Blue. SEAL Team Six specializes in Maritime Counter Terrorism (MCT), including hostage rescue and elimination of terrorists on ships and oil platforms, et cetera – but is also capable of broader counterterrorism tasks.

SEAL Team Six is organized into four squadrons, codenamed Red, Blue, Gold, and Silver Squadrons, each comprising around 50 operators, and each squadron is divided into three troops, with troops generally divided into teams of fighters and snipers. There is some indication that DEVGRU includes a Gray Squadron, which is a specialist boat squadron dedicated to maritime operations, and also a Black Squadron, which specializes in reconnaissance and surveillance. The members carry out advance clandestine intelligence gathering ahead of a strike operation, and appear to operate out of US embassies in trouble spots around the world. The squadron is also reputed to include female operators, where in some situations a woman, either alone or paired with a male operator, can create a softer profile than a lone man or team of men. According to the *New York Times*, Black Squadron has more than a hundred members.

In 1983 a situation arose between the US and the Caribbean island nation of Grenada, involving the safety of the US citizens living there. Action was taken to invade the island to guard those who faced harm. SEAL teams were allocated to the US forces as part of the assault and provided beach reconnaissance for US Marines who would land at Pearls Airfield. They then moved to the west side of the island, where they performed three other beach recon missions. While the traditional role of beach recon was carried out, another SEAL team was tasked with the extraction of Grenada's governor-general and the capture of Grenada's single radio tower. That part of the mission ran into problems and they were engaged by a large force of Grenadian and Cuban troops. Unable to get support, they destroyed the radio station and fought their way to the water, where they evaded the enemy forces. When able, they swam out to sea, where they were picked up several hours later after being spotted by a reconnaissance aircraft.

On the night of 19 December 1989, the United States invaded Panama, and that involved the SEALs, who were given two missions: the first was to locate and disable a boat that President General Manuel Noriega could use to escape; the second was to locate and disable Noriega's Learjet at Patilla Field, which he could also use to escape.

The team located the boat and placed explosive charges under the hull to ensure that it could not be used. To guarantee the success of the mission, so much explosive was used that one of the boat's engines was never found.

For three SEAL platoons the target was the airfield, which they infiltrated using Zodiac F-470 combat rubber raiding craft provided by Special Boat Unit 26. They were landed at the southern end of the airfield in darkness and clandestinely moved ashore on their mission to deny use of Panama's Punta Paitilla Airfield to General Noriega and key Panamanian Defense Force (PDF) personnel. The mission at the airfield was successful, but in the ensuing fire fight with defending forces four SEALs were killed and eight seriously wounded.

US Marine Corps

The United States Marine Corps is considered by military commentators to be the most powerful amphibious fighting force in the world, and within that organisation are small specialist units, the Recon Marines and Marine Raiders, who are the ‘eyes and ears’ for the Marine amphibious units and other special operations.

The Marine Raider Regiment comes under Marine Special Operations Command (MARSOC), and the major difference between MARSOC and Force Recon is that the former is under the command of SOCOM, whereas Force Recon is under the USMC Marine Expeditionary Force Commander.

For the purposes of identifying the role of the combat diver in the Marine Corps, all Reconnaissance Marines receive advanced training in combat diving. For Marine Raiders, gaining specialist training as a combat diver is one of individual preference.

The Reconnaissance Marine is a Marine with some operational time served, who can be taken to another level to become skilled in covert amphibious methods and land reconnaissance and surveillance to meet the needs of the Marine Expeditionary Force (MEF). They have to maintain their skills in combat diving, combat surface swimming, working with small boats, short and long range patrolling, close combat skills, demolitions, forward observer procedures for naval gunfire support and air strikes, low level static line (LLSL) parachuting, and military freefall parachuting. The selection and training course for Recon Marines is intensely rigorous, and much of it involves swimming and underwater training, in addition to timed marches and other land-based physical fitness tests, but they do have a sound base from which to select.

Information available from a number of sources indicates that the dropout rate is high, with over 50 per cent of candidates who attempt Recon selection dropping out. Of those that do not pass selection, half are failed due to medical reasons. Of the other half, nearly a quarter of all candidates voluntarily choose to quit, or ‘Drop on Request’, and there are those who the training staff decide are not suitable. A high dropout rate is a testament to how challenging both the physical and mental aspects of Recon selection are. Those who succeed are assigned to one of the three active duty Recon Battalions and one reserve, which is directed by the USMC Marine Expeditionary Force Commander.

The Force Reconnaissance Company is independent of the Division Reconnaissance Battalion, although this also has Marines trained in the use of inflatable boats and surface swimming, and a number trained in underwater diving. The Force Reconnaissance Company has a headquarters platoon, which identifies the requirements and plans in operation to allocate to the operational teams. A Supply and Service Platoon provides logistic support and comprises a platoon HQ, supply section, mess section, parachute maintenance and repair section, and an amphibious equipment maintenance section. The Reconnaissance Platoons each comprise three teams, which are subdivided into patrols of six men,

NEXT PAGES
A team of SEALs equipped with the Draeger closed-circuit oxygen rebreather. (Photo by Richard Schoenberg/Corbis via Getty Images)

and the six platoon commanders are normally employed as task organization commanders for one or more teams. Platoons can be deployed in the small sub-units of six men, or in larger teams, depending upon operational requirements.

The role of Force Reconnaissance Company is a flexible one, and while the survey of a beach would normally be carried out by SEAL units, Force Recon can do the job if required to do so. They will undertake deep reconnaissance before and during a landing, and are inserted by parachute, inflatable boat, or by swimming on or below the surface to the beach area. Once ashore they avoid the enemy and move inland to seek out defences, and if required can summon fire support from ships or aircraft. They remain mobile, carrying minimal equipment, and as they gather information it is transmitted to the force commander.

The MARSOC website states:

> Our mission is to recruit, train, sustain and deploy scalable, expeditionary forces worldwide to accomplish special operations missions assigned by US Special Operations Command (USSOCOM). To accomplish that, MARSOC equips and trains Marines to succeed in austere conditions against a wide range of adversaries. Marine Raiders execute complex, distributed operations in uncertain environments, achieving silent success and strategic impact.
>
> Our vision is to be America's force of choice to provide small lethal expeditionary teams for global special operations. With tight-knit teams of agile and adaptable operators, we will continue to punch well above our weight class.

Marine Special Operations School in Camp Lejeune, NC, screens, trains, assesses and selects Marines to become MARSOC Raiders. The main component of the school is the Individual Training Course (ITC), which is nine months long and charged with the role of taking an experienced Marine of at least three years' service and making them a Special Operations Marine Raider.

While Recon has the principal task of covert infiltration and gathering information, the Marine Raiders will, as the name implies, carry out raids. The Marine Raider Regiment comprises the 1st Marine Raider Battalion, 2nd Marine Raider Battalion, and 3rd Marine Raider Battalion. The battalions are divided into four companies, and each company has four Marine Special Operations teams. In addition, the Raider battalions are supported with logistics, communications, dog handlers, intelligence, and fire control technicians, depending on operational requirements, allowing special operations missions to be undertaken around the globe. Not all MRR operators are combat diver trained; however, such training is available as a specialist skill on an individual basis. For operational purposes, those who are combat diver trained can combine when required or they can bring in Recon Marines to support the mission. Another important role for the MRR is to

OPPOSITE
US Marine recon divers enter the water using the Draeger closed-circuit rebreather. They check for leaks in the system before submerging. (US Marine Corps photo by Carden Hedelt/Released)

advise, train and assist selected nation forces so as to enable them to undertake internal security and provide stability by countering subversive activities and reducing the risk of violence from internal and external threats.

Agrupación Buzos Tácticos (APBT)

The Agrupación Buzos Tácticos (APBT) is the maritime special operations force of the Argentine Navy, with highly qualified combat divers trained to perform underwater missions including beach surveys, attacks on specific targets and information gathering. Selection for the unit is open to officers and NCOs, and as with all such units it is very selective and has a high failure rate.

In the 1982 invasion of the Falkland Islands the main landing on 2 April, at Yoke Bay to the east of Port Stanley, was preceded by an amphibious reconnaissance unit of the Buzos Tacticos, a special operations force of the Argentine Navy who are combat divers with EOD/demolition skills as well as parachutists. They had been landed by the submarine ARA *Santa Fe* and secured the beach and the lighthouse, and set up beacons to guide the amphibious craft of the assault group of the Agrupación de Comandos Anfibios (APCA), which is a special operations force of the Argentine Marine Corps. The Buzos Tácticos divers joined up with the APCA taking part in the battle of Government House and the assault on Moody Brooks barracks.

Buzo Tácticos combat divers with captured defence force Royal Marines Commandos who eventually were to raise the British flag following the defeat of the Argentine forces. (Photo by Rafael WOLLMANN/ Gamma-Rapho via Getty Images)

US Army: the 'Green Berets'

US Army Special Forces Combat Diver badge. (Author's Collection)

The US Special Forces 'Green Berets' are a unique combination of Ranger, Paratrooper and teacher. They specialize in communications, intelligence operations, demolitions, weapons and medicine, with each man being cross-trained to take another's place in an emergency. They are primarily a land-based operational force, formed of 'A-Teams'.

The Special Forces Operational Detachment Alpha is better known as ODA. ODAs comprise 12 team members, usually consisting of a commanding officer, a warrant officer, a team sergeant, an intelligence sergeant, two medical sergeants, two weapons sergeants, two communications sergeants, and two engineer sergeants. Being cross-trained in all skills enables them to operate under all conditions, whether in jungle, on mountains, in snow, or in the desert – an A-Team is a complete operational unit.

By having 12 members, with two soldiers for several of the roles, the team is able to split into two splinter teams when needed. There are six detachments assigned to each Special Forces Company. There are three companies per battalion, and four battalions per Special Forces Group. Currently, there are seven Special Forces Groups: five active duty, and two National Guard.

The Special Forces soldiers are trained to infiltrate deep into enemy-held territory, using advanced parachuting and diving techniques, to locate enemy forces and logistics establishments which might not be locatable by other means. Green Berets also train as combat divers, and each Special Forces Company includes a 12-man ODA that specializes in diving and small boat operations.

Parachuting is a quick and efficient method, using HALO (High Altitude Low Opening) or HAHO (High Altitude High Opening) techniques, but water infiltration has developed into a specialized skill through the training facilities of the SEALs. The Green Beret is able to use small boats, undertake missions from submarines, and use closed-circuit underwater breathing apparatus. With the combined skills of parachuting, boat work, and both surface and underwater diving, the A-Teams have a high degree of infiltration expertise. Apart from seaborne diver intervention, they also operate in rivers, lakes and reservoirs.

While part of the US Army, they cross-train with other US special operations forces and those of other nations, such as the British Special Air Service. They are an independent autonomous group who have an active role in modern warfare. In Vietnam in 1969 they had 11 groups encompassing over 13,000 men. Following the American withdrawal from Vietnam, the

A combat diver comes ashore as part of a covert sea insertion. Weapons are ready to use at all times and this is a dangerous place to be. Diving equipment is kept ready in case there is a rapid withdrawal. (US Marine Corps photo by Sgt Christopher Q. Stone, 26th MEU Combat Camera/ Released)

Green Berets were reduced in numbers in 1980 to three groups of about 3,000 men, and submarines which had been converted for Special Forces operations were mothballed. However, the US government swung back in favour of the Special Forces, so part of the Green Berets' role is to support the Rapid Deployment Force, as well as having training teams to assist friendly forces faced with outside aggression.

In 2021, Sofrep, a US online military information source, stated that when people reference Special Forces, they refer to them as 'Green Berets' because all who pass selection are awarded the green beret, signifying that they are Special Forces. The choice of the green beret was decided in 1954 when Special Forces adopted it to make them identifiable, but it was not part of their official uniform and they were told they could not wear it. This was ignored, and they continued to wear the headgear. In 1961 the green beret was made an official part of the uniform, and President Kennedy ordered that it could only be worn by Special Forces soldiers. He stated that the beret was 'a symbol of excellence, a badge of courage, a mark of distinction in the fight for freedom.'

Once successful, the Green Berets move to their assigned units and are immersed in continuation training, where they have the opportunity to attend advanced specialist training such as the Combat Diver Qualification Course, the Military Freefall Parachuting Course, or the Special Forces Sniper Course.

The seven-week Combat Diver Qualification Course (CDQC), at the Special Forces Underwater Operations School in Key West, Florida, is intense both mentally and physically, with a high attrition rate. Students learn to become proficient in the use of closed-circuit rebreather diving equipment, which is able to recycle the breathing gas and allows combat divers to remain underwater for up to four hours, meaning that the divers can infiltrate strategic locations from further offshore. The course focuses on surface and sub-surface waterborne infiltration methods. The school also runs two other courses: the Combat Diving Supervisor Course and the Diving Medical Technician Course. The centre comprises a purpose-built self-sufficient organisation with an administrative and training facility, barracks, dining facility, classrooms, parachute-drying tower, hyperbaric chamber, boat maintenance workshop, docks, the largest pool in Key West, and a dive tower equipped with a nuclear submarine lockout trunk. Qualified divers can evolve to undertake missions that require parachuting into the water and entering a submarine or placing underwater explosives.

Sergeant Major Roberto Oquendo, company sergeant major and the senior enlisted advisor to the commander, has stated:

> I want to choose my words very carefully here, because this [combat diving] isn't for everybody, just like Airborne School is not for everybody. Not everyone who is Special Forces is high altitude/low opening qualified. Of course… These specialties are one notch above the standard [Special Forces] duties. We need that, which is why we have these specialty teams, like dive teams and HALO teams.

Sergeant Angela Walter of the 10th Special Forces Public Affairs Office published an article on 23 November 2020 titled 'Combat Divers submerge inside Cheyenne Mountain – The opportunity arose for the Special Forces Operations Detachment - Alpha (SFOD-A) with 10th Special Forces Group (Airborne) to exercise their combat dive skills in an unusual location, in the heart of the Cheyenne Mountain Complex.' The 10th SFG dive teams are cold-water dive teams, meaning that they specialize in cold-weather maritime special operations. Their focus is on cold-weather operations, as their operational area is Europe.

The Cheyenne Mountain Complex is a Space Force base located inside a mountain that houses several military operational facilities, ranging from electronic surveillance to missile defence to aerospace operations. In addition, the Complex serves as the alternate headquarters for the North American

Aerospace Defense Command (NORAD), US Air Force Space Command and US Northern Command (USNORTHCOM), which are headquartered nearby at Peterson Air Force Base. The Complex is designed to operate independently from outside help, so the condition of its reservoirs has to be perfect to allow it to function 24/7.

There are three reservoirs inside the complex, holding water for a variety of uses, which include cooling the mountain base's generators and expelled exhaust. Because the mountain is designed to function independently, the water systems are vital to the success of the mountain's operations. Assessing the structural integrity of the reservoirs and ensuring the water is flowing freely through the cave systems that connect them keeps things running smoothly, and that is achieved by inspections by divers.

Special Forces diving operations are not a regular occurrence, so the opportunity to undertake a dive operation outside of their missions of infiltrating into an enemy country or territory is a valuable exercise. Combat divers have not been a priority during the wars in Afghanistan, Iraq, and Syria, where the opportunities for underwater operations were almost non-existent, so funding and training were surpassed, leaving a void. The focus has shifted rather rapidly, as the main potential adversaries now are maritime nations, the operational hunting ground for combat divers.

Combat diver units deploy throughout the world, meeting their assigned roles and responsibilities. The demand for unconventional warfare missions is not going away; rather, in the current climate, it is evolving. The Special Forces are a key component in projecting the United States' global standing, and with many of the chief protagonists having long coastlines, the combat diver is a key player.

The Netherlands

Maritime Special Operations Forces (NLMARSOF)

When the predecessors of the Maritime Special Operations Forces (MARSOF) of the Netherlands Marine Corps were created in 1959, the first Marine combat divers were trained to be skilled in covert insertion, defusing mines, and tactical reconnaissance missions in advance force operations of amphibious landings. Their new skills included exiting and re-entering the submarine through an airlock, while remaining underwater and away from the coast. In 1969 they made contact with the British Special Boat Service (SBS), who became responsible for the training programme for their Dutch counterparts. Towards the end of the 1970s frogmen were required to operate in the icy waters off the Norwegian coast in defence of the northern flank of the NATO territories, a task shared with the British SBS. The outcome was for the official integration of the Dutch Marine underwater reconnaissance specialists in a squadron of the SBS as 7 Troop (NL) SBS.

With the decline of the old Soviet Union the requirement for special forces combat frogmen became less relevant and the combat divers found themselves in more of a land and ship role, with a move of emphasis to anti-piracy missions. Instead of the icy waters of northern Norway they found themselves in warmer climes, in the Adriatic Sea, the Persian Gulf and the Indian Ocean off the coast of Somalia. Their special forces skills were required in Bosnia, Iraq, Afghanistan and West Africa, integrating with other special forces, but they still had to maintain their specialist skills as combat frogmen. Somalia evolved as a breeding ground for piracy and privateering gangs who saw rich pickings in the numerous merchant vessels that passed by, where the sole aim was to take over ships and collect ransoms for the ships, crews and cargoes. They were prepared to use violence to achieve their aims. To expand their operations they introduced mother ships (dhows), which could provide support for small, fast boats used to attack the large vessels – which numbered between 20,000 and 30,000 vessels passing through the Gulf of Aden every year. This activity generated an international response, and the Dutch Marine frogmen found themselves pitted against this new enemy.

The Netherlands Marine Corps – Korps Mariniers – is part of the Royal Netherlands Navy, and is the elite infantry who specialize in amphibious warfare. As such, they are a rapid reaction force, which can be deployed to any location in the world within a maximum of 48 hours.

The major combat elements of NLMARFOR are two battalion-sized units, called Marine Combat Groups, with the 1st Marine Combat Group providing the main contribution of the Netherlands Marine Corps to the United Kingdom/Netherlands Landing Force (UK/NL LF), where the Netherland's Marines integrate with the UK's 3rd Commando Brigade Royal Marines. This closeness of the two Marine Corps gave rise to the nickname of the Dutch Marines among their British Royal Marine counterparts as 'Cloggies', due to the stereotype that most Dutch wear clogs, instead of 'normal' footwear.

1st Marine Combat Group comprises:

- Command Staff
- 10th Reconnaissance, Surveillance and Target Acquisition Squadron (10 RSTA Sqn)
- 11th (Parachute) Raiding Squadron (11 (Para) R Sqn)
- 12th Raiding Squadron (12 R Sqn)
- 13th Raiding Squadron (13 R Sqn)
- 14th Combat Support Squadron (14 CS Sqn)
- 15th Combat Service Support Squadron (15 CSS Sqn)

2nd Marine Combat Group comprises:

- Command Staff
- 20th Reconnaissance, Surveillance and Target Acquisition Squadron (20 RSTA Sqn)

- 21st Raiding Squadron (21 R Sqn)
- 22nd Raiding Squadron (22 R Sqn)
- 23rd (Parachute) Raiding Squadron (23 (Para) R Sqn)
- 24th Combat Support Squadron (24 CS Sqn)
- 25th Combat Service Support Squadron (25 CSS Sqn)

Each Marine Combat Group is commanded by a lieutenant colonel, with a complement of 726 men, and the Command Staff of 30 men. In order to be able to undertake its amphibious role, the Surface Assault and Training Group (SATG) provides the Marines with a variety of vessels. The Group consists of some 241 men. There is an Amphibious Support Group, which provides logistical support for the SATG.

There is a Landing Craft Utility (LCU) Troop, which provides five Landing Craft Utility with their crews and a Landing Craft Vehicle Personnel (LCVP) Troop, which provides 12 LCVPs with their crews. The Dutch LCVPs are the smaller of the two landing vessels, carrying troops and some smaller vehicles, and for a beach landing they will deliver the majority of the assault troops. The larger Dutch LCUs were upgraded in 2006, having been stretched by 9 metres to decrease their draft, which increased their load-carrying capacity by 20 tons and allows them to get closer to shore. They can carry troops, but also vehicles including tanks. Both craft are carried aboard the two Landing Ship Docks (LSDs), HMLMS *Rotterdam* and HNLMS *Johan de Witt*. The *Rotterdam* has two LCUs plus three LCVPs in its dock, while *Johan de Witt* has the capacity to transport two LCUs and four LCVPs in davits.

Also in the group is a Fast Raiding Interception and Special Forces Craft (FRISC) Squadron, which provides three troops: a troop with Raiding Craft for the Marine Combat Groups; a troop with Maritime Counter Terrorism Crafts (MCT) for the Maritime Counter Terrorism Squadron; and a troop with Special Operation and Interceptor Crafts for the Conventional Squadron of the Maritime Special Operations Forces.

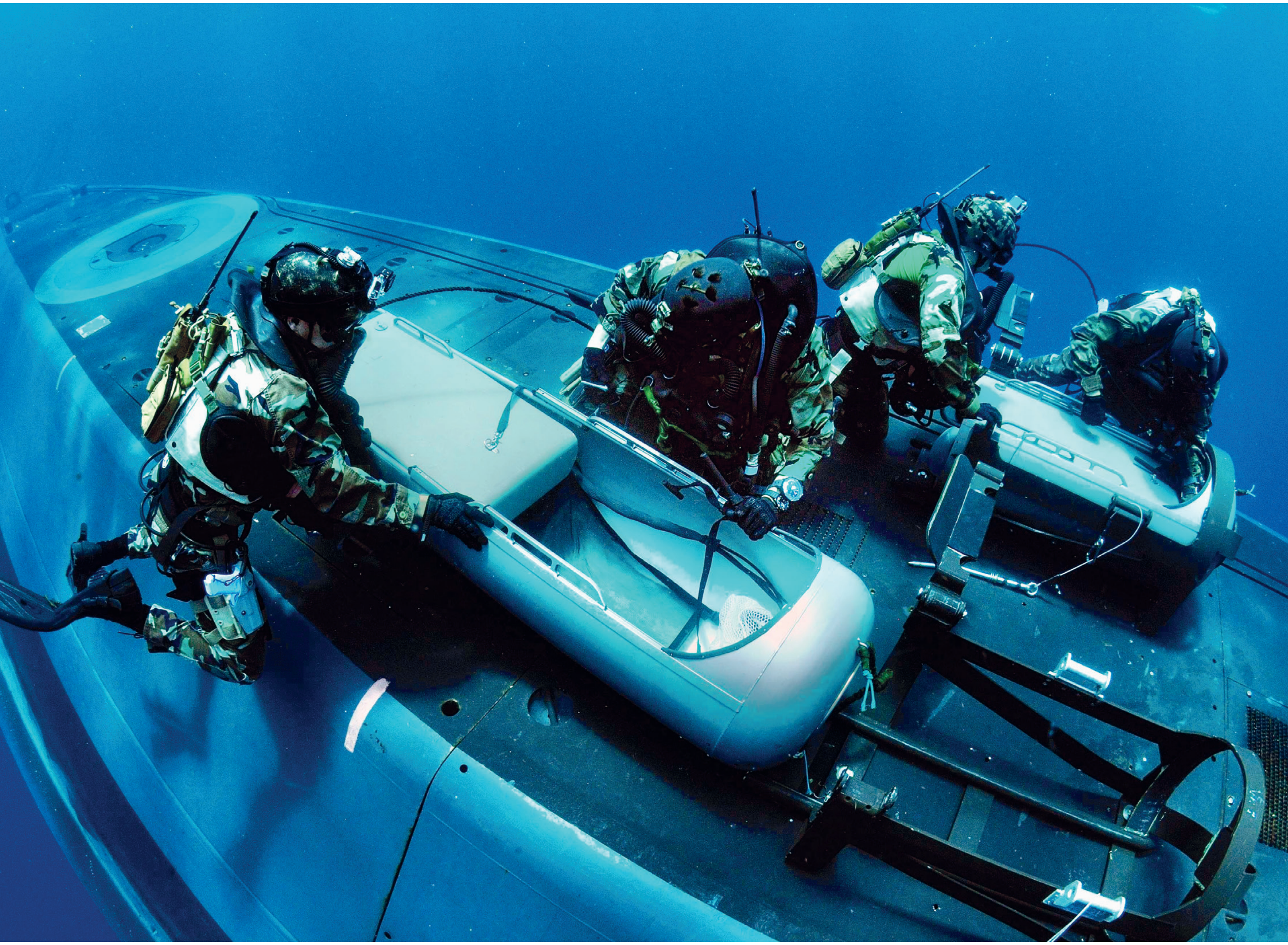
The two Landing Craft Control Teams – a Landing Craft Control Team Light, and a Landing Craft Control Team Heavy – comprise a staff, a Beach Recce Group, a Beach Control Group, and a Heavy Vehicle Group. Both Beach Recce Groups field a team of frogmen to clear mines, barriers and other obstacles from landing beaches.

The 32nd Raiding Squadron (Dutch Caribbean Forces) consists of some 153 personnel stationed in Aruba, and is responsible for the defence of the Netherlands Antilles. The Squadron falls operationally under the command of the Naval Commander of the Caribbean (CZMCARIB), and is stationed at the Korps Mariniers Barracks Savaneta (Aruba). Apart from providing a defence force, the Marines on Aruba also participate in anti-drug operations. The squadron is commanded by a major, and consists of: headquarters; three raiding troops; a FRISC troop, with 12 boats; and a combat service support

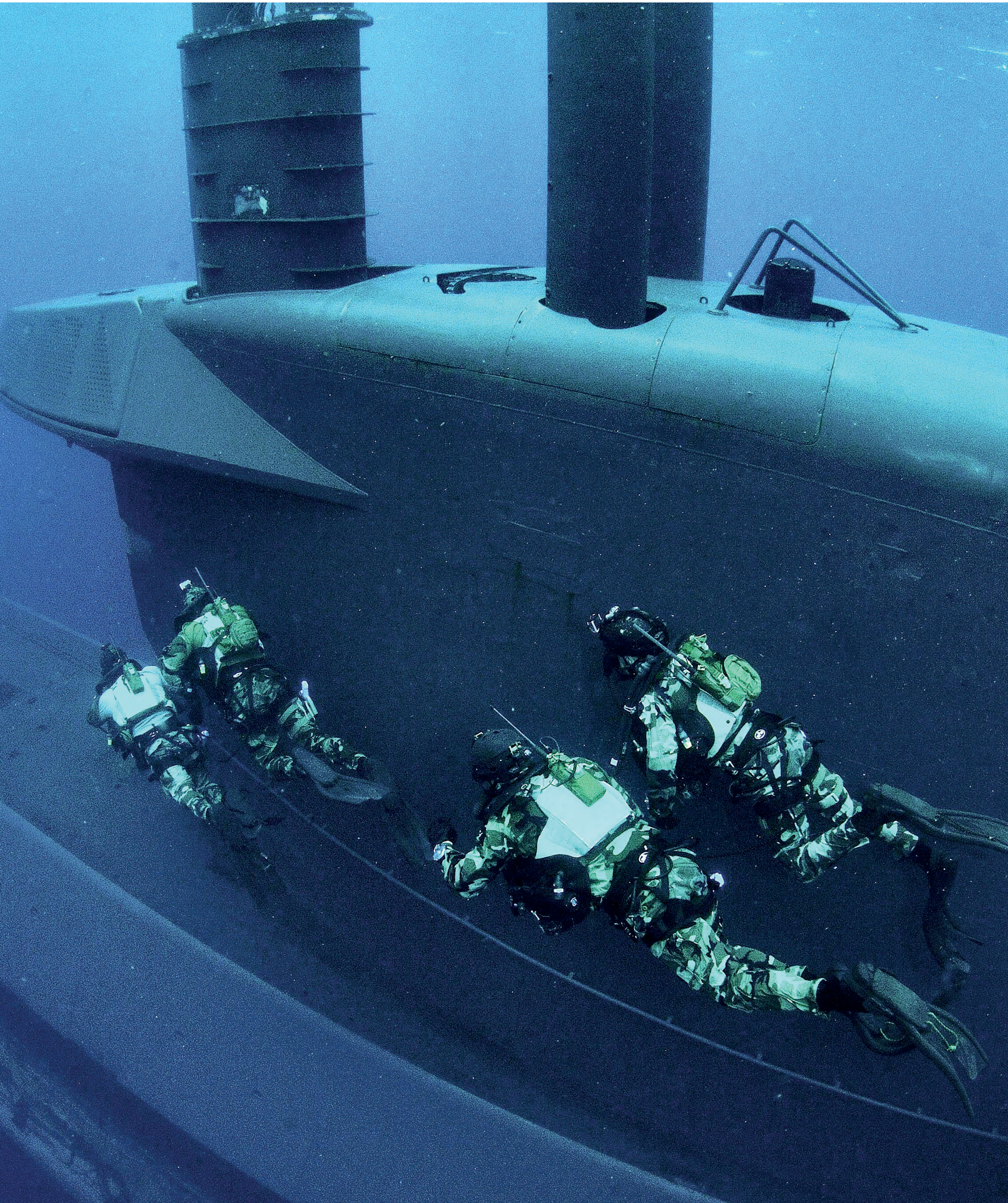
troop for transport, logistics, maintenance and medical care. The Squadron is regarded as an essential line of defence for the island of Aruba.

Members of the Squadron are able to cross-train with allies, for example when the US Marines of Charlie Company, 2nd Reconnaissance Battalion (Recon Bn), 2nd Marine Division (MARDIV) travelled to the island to conduct open-water and dive training with NLMARSOF, who always send a team of special forces frogmen to support them as they know the underwater area well and they assist them with dive safety measures. The frogmen also exercise and train with the US Navy SEALs, where there is a closer bond.

The important and valued link between the UK and the Netherlands was established in 1972, when units of the Netherlands Marine Corps formed part of the British 3 Commando Brigade for exercises and real conflict situations.



Dutch Special Operations Forces frogmen preparing Diver Propulsion Devices (DPDs) in their storage space on a submarine. (NLMARSOF)



Also, the Mountain Warfare/Force Reconnaissance Troop of C-Squadron NLMARSOF is placed under UK operational command as part of C-Squadron, UK Special Boat Service (SBS). Together, these form the UK/NL AF. There is also an integration of the Dutch SF frogmen and the British SBS. Either the First or the Second Marine Combat Group can be assigned as the Dutch contribution to this force where the UK/NL AF contributes to the European Multinational Maritime Force (EMMF).

Maritime Special Operations Capable – MARSOC occurs during operational training, where there is more emphasis on various other tactics in amphibious warfare, and it will take about a year to become MARSOC certified, which will last for two years. SOCs are able to operate within any environment in the world, under any condition and circumstance, so Dutch Marines regularly train in arctic, jungle, desert, high altitude, maritime and urban environments, as well as embarking on various training missions throughout the world. During the two years SOCs will work closely with Maritime Special Operations Force (MARSOF) platoons throughout the world, and can choose to apply to join them for further specialization. Experienced Marines are able to obtain various specializations, and it is common for Marines to have multiple skills, such as radio specialist, sniper, free-fall parachutist, force reconnaissance or special forces.

The Netherlands Maritime Special Operations Forces (NLMARSOF) are the Marine Corp's elite units, and are divided into three squadrons and a Logistic Support Group. The three squadrons are: C (Conventional), M (Maritime Counter Terrorism) and T (Training). The NLMARSOF C-Squadron is created around the mountain leaders and frogmen, and to become an NLMARSOF operator SOC Marines will have to successfully fulfil an aptitude phase, before undertaking a maritime special forces training course, which takes about a year, after which they will join M-Squadron, or they can opt to specialize further for C-Squadron and become a mountain leader or frogman. As would be expected, these courses are among the toughest in the world, and only about 40 per cent of applicants will pass.

One problem which has risen in recent years is the high demand on NLMARSOF to operate in Afghanistan, Iraq, Mali and other places, which has produced difficulties in maintaining all frogmen at an operational level because they do not have access to water for training. The regulations on diving have become very strict, and that demands maintaining levels of diving competence next to all the other required training, so it was decided to have diver sections within the squadrons to fulfil the specific diving tasks.

The Maritime Counter Terrorism Squadron (M-Sqn) consists of two troops, and is a special forces unit. The Conventional Squadron (C-Sqn) is also a special forces unit operating mostly at sea, but also used for strategic reconnaissance in advance of landing forces in amphibious operations. C-Squadron fields two troops, one specialized in underwater operations, and the other specializing in arctic/mountain warfare.

OPPOSITE
Two DPDs move away from the submarine carrying four combat frogmen. (NLMARSOF)

The frogmen troop can be deployed by parachute, submarine, and various other underwater transport. The Training Squadron (T-Sqn) trains all men who are part of the Maritime Special Operations Forces. The Logistic Support Group (LSG) provides logistic support and equipment to the Netherlands Maritime Special Operations Forces.

MARSOF has in its armoury the STIDD DPD (Diver Propulsion Device), which can be carried by submarines, and allows frogmen to exit the submerged boat, take the devices from their storage space, and use them to transport the frogmen on their mission. Such equipment reduces the energy, and therefore the amount of breathing gas, required for underwater swimming, and carries the diver quicker. With one frogman on the device a second can be towed and, depending on the operation requirements, can carry equipment such as limpet mines, weapons or spare underwater breathing sets. They would be useful in the recovery of an incapacitated frogmen.

Israeli Dive Operations

In 1969 divers from Israel's Naval Commandos were given the objective of infiltrating a fortified position and clearing a path for a demolition team, who were themselves tasked with destroying a radar station. The fort was situated on an island at the southern entrance to the Suez Canal, and was manned by Egyptian artillery and commando troops. Although the sea was calm and only a light wind could be felt, there was a strong current which made it hard going for the assault force aboard their rubber inflatable boats. Nearing the target the leader gave orders for the assault divers to get ready, so the six men put on their underwater breathing sets, prepared their weapons and equipment, then entered the water. The leader took a compass bearing before the team submerged and began the swim. The heavy current was causing a problem and when the leader broke the surface to obtain a position fix and compass bearing, he found that they were off course. Making an allowance for the current, he set a new course, and submerged below the surface, leading the team towards the target.

Reaching the island, the divers surfaced carefully, discarded their underwater breathing apparatus and prepared their weapons for use. The first task was to cut a path through the barbed wire defences which surrounded the concrete wall at water level. This phase required the divers to stand up to their chests in water while cutting the wire, with enemy guards standing above them. When they had cut a path through, they moved and opened fire on the guards standing on the roof of a bunker.

As they opened fire, their fire support unit also engaged the enemy, causing the enemy a great deal of confusion as the divers moved up the wall, neutralizing any

enemy troops they encountered using automatic fire and hand grenades. During this action the leader of the team received a wound to the head, but was able to continue with the raid. Once the object of the attack was secured the demolition team was called in, and they placed explosive charges in the radar installation. At this point the Israeli divers had no losses, and while the divers secured their target other commandos stormed the fort, engaging the main defending force.

On the second raid the divers left their rubber inflatable boat and, laden with mines, swam into the target area at the Egyptian Naval Base at Ras Sadat. They found two P-183 motor torpedo boats, to which they fixed their mines, then extricated themselves and re-joined their waiting boat. A second team who were acting as a back-up had already swum to the target, where they placed their charges on the two other boats. They too were able to return to the boat without detection and both teams were aboard their raiding craft by the time the explosions indicated that the raid had been successful.

Australia

Australian Navy clearance divers

At the forefront of Australian combat divers is the Clearance Diving Branch of the Royal Australian Navy, which was formed in 1951. Its primary role is the location, identification and disposal of underwater mines, with a secondary role of underwater maintenance, training of the fleet in ship defence against saboteurs, beach reconnaissance and minor salvage. While explosive ordnance disposal remained a primary function, it soon became apparent that Navy divers could adapt to an ever expanding variety of tasks. In 1966 there was a change that marked the formation of clearance diving teams. In that same year AUSCDT 3 was formed and trained in all aspects of EOD, small arms and jungle survival before being deployed to Vietnam. It was their service in Vietnam that was to change the way the clearance divers (CDs) operated, after very complimentary reports from the Americans came to the notice of senior Royal Australian Navy (RAN) officers as to the high-level operational status of the CDs. They had fought against the world's most committed and resourceful guerrilla soldier, to the extent that the Vietcong put a price on their heads. Some of this ability might have evolved from having had to develop and hone their skills 'in house'. This had necessitated an extreme level of improvisation, which bred an independence that makes the Australian clearance diver of today quite unique in the world of military diving.

Royal Australian Navy clearance divers and Australian Army soldiers from 2nd Commando Regiment combine in the maritime counterterrorism role as part of Tactical Assault Group (East), or TAG (E), a short-notice counterterrorism force able to respond to a terrorism incident of national importance, or in support of state/territory-based police. The clearance divers

are integrated into TAG (E) as maritime counterterrorism specialists, bringing their skills of maritime planning, diving, demolitions and small arms.

The Clearance Diving Branch force elements are:

1. Maritime Tactical Operations (MTO):
   - Clandestine beach reconnaissance (including back of beach operations up to 2km inland)
   - Clandestine hydrographic survey of seabed prior to an amphibious assault
   - Clandestine clearance or demolition of sea mines and/or obstacles
   - Clandestine placing of demolition charges for the purpose of diversion or demonstration (ship/wharf attacks)
   - Clandestine document collection
2. Mine Counter Measures (MCM):
   - Location and disposal of sea mines in shallow waters
   - Rendering safe and recovering enemy mines
   - The search for, and disposal of, ordnance below the high-water mark
   - Clearance of surface ordnance in port or on naval facilities
   - Search for, render safe, or dispose of all ordnance in RAN ships and facilities
3. Underwater Battle Damage Repair (UBDR):
   - Surface-supplied breathing apparatus diving
   - Use of underwater tools including: welders, explosive nail-guns, and pneumatic drills and chainsaws
4. Task Group Explosive Ordnance Disposal (TGEOD):
   - Each team is a self-contained, highly mobile unit consisting of about 60 personnel
   - Within each team there are three distinct elements: Underwater Battle Damage Repair (UBDR); Mine Counter Measures (MCM); and Maritime Tactical Operations (MTO), with team members receiving instruction in all three disciplines
     - UBDR are trained in the use of pneumatic and hydraulic tools, and carry out salvage and emergency repair work in wartime situations
     - MCM is concerned with the disarming and disposal of mines and explosive ordnance, including IEDs (Improvised Explosive Devices) as favoured by terrorists
     - MTO carry out amphibious reconnaissance and are skilled in escape and evasion techniques.

The primary focus of a clearance diver is to perform explosive ordnance disposal. This role is conducted at sea on ships, particularly in the vulnerable approaches to ports and anchorages; onshore in port facilities and installations;

OPPOSITE TOP LEFT
RAN clearance divers and Australian Army soldiers from the 2nd Commando Regiment combine for maritime counter-terrorism operations. Boarding a ship while under way is one of the hazardous methods used. (Australian Department of Defence)

OPPOSITE TOP RIGHT
RAN clearance divers and Australian Army soldiers from the 2nd Commando Regiment are trained to parachute into water with their equipment bags lowered below them. (Australian Department of Defence)

OPPOSITE BOTTOM
Expeditionary Reconnaissance and Clearance divers move closer to shore, ready to take to the water to complete their mission. Divers either side are ready to drop into the water. (Australian Department of Defence)

ABOVE
Clearance divers work with Commandos on maritime anti-terrorist operations. (Australian Department of Defence)

in the coastline environment associated with amphibious advanced force operations; and currently in support of the Australian Army during land-based combat operations.

Clearance divers (CDs) are the Australian Defence Forces' specialist divers. CD tasks include: specialist diving missions to depths of 54 metres; surface and underwater demolitions; and to render safe and dispose of conventional explosive ordnance and improvised explosive devices. During their careers, CDs will be rotated through the following sea and shore positions:

- Expeditionary Reconnaissance and Clearance (ERC), delivering overt and clandestine mine countermeasures while diving in shallow water and coastal environments. This encompasses reconnaissance, rapid environmental assessment, and mine/obstruction location and identification, and clearance where required. These missions include diving on oxygen and mixed-gas closed and semi-closed rebreathers, and the employment of specialist reconnaissance equipment.
- Clearance divers serve on Mine Hunter Coastal (MHC) vessels, where specialist diving duties involve the use of self-contained mixed-gas equipment for mine countermeasures tasks.

- Underwater Damage Repair (UDR) missions include diving on surface-supplied and self-contained air equipment, primarily for rapid deployment to conduct emergency ship repairs. UDR also assists in repair and maintenance of ships' underwater fittings, underwater survey, repair and salvage. These missions can involve the use of underwater electric, explosive-power, hydraulic and pneumatic tools for major repairs and salvage operations, and provide a suite of skills and equipment that can be applied in humanitarian assistance and disaster relief scenarios.
- Maritime Explosive Ordnance Disposal (MEOD) missions include the rendering safe and disposal of improvised explosive devices (IEDs), military ordnance, and obstructions in the maritime environment, including: on land; wharves; ships' internals and hulls; and underwater installations. These missions can involve the use of remote positioning vehicles (RPV), portable X-ray devices, bomb suits, high powered disruptors, and various diving sets and underwater tools.

ABOVE LEFT
CDs train to undertake boarding of suspect vessels where speed is essential in a maritime anti-terrorist mission. Boarding from moving vessels is a high-risk activity. (Australian Department of Defence)

ABOVE
CDs work with a wide range of equipment to carry out underwater searches and surveys when not undertaking covert operations. (Australian Department of Defence)

TAG (E) is where CDs are employed in special forces roles at the TAG (E). TAG (E) is part of 2 Commando Regiment. TAG (E) maintains a short-notice

capability to conduct special military operations, using a variety of specialist skill-sets that include the extensive use of small arms.

CDs are also posted to the RAN Diving School, located at HMAS Penguin in Sydney, for instructional duties. RAN Diving School staff instruct all category and non-category diving and demolition courses. Besides the RAN Diving School, there are several administrative support positions for CDs around Australia.

Australian Clearance Diving Teams One and Four

Australian Clearance Diving Team One (AUSCDT ONE) is structured into four elements of ERC, MEOD, UDR and a Command and Support element. Through the use of some or all of these elements, the unit is capable of performing improvised explosive device disposal (IEDD), explosive ordnance disposal (EOD), very shallow water mine countermeasures (VSW MCM), reconnaissance, mine countermeasures, and surface-supplied breathing apparatus (SSBA) diving for the use of underwater electrical, hydraulic and pneumatic tools including welding, ultra-thermic cutting, chainsaws, grinding, jackhammer, and lift bag operation.

Australian Clearance Diving Team Four (AUSCDT FOUR) are specialist divers, who operate in-service diving equipment to the maximum permissible depths. They also conduct explosive ordnance disposal for the Navy, and are capable of locating, and destroying or recovering, underwater ordnance or maritime assets. Team Four has always been at the forefront of operational activity. Between 1980 and 1985, it provided personnel to the counterterrorist squadron of the Special Air Service Regiment.

The team consists of a headquarters element and three operational elements which specialize in tactical operations, mine countermeasures, and battle damage repair. All elements are capable of performing explosives disposal and can be deployed independently or as a combined task unit. Their equipment enables the team to locate and dispose of modern mines that feature sophisticated arming and targeting systems. Australian Clearance Diving Team Four personnel are also trained in field craft and the use of a wide range of small arms, enabling them to deploy to remote operating areas under varying levels of threat.

Australian Defence Force (ADF) has an amphibious warfare capability which exploits the maritime environment and achieves freedom of manoeuvre, and unlike land-based forces, a maritime force can use the sea as an open medium by which to choose the time and place of landing. They are not reliant on forward operating bases, permissive entry or host-nation support, making them highly responsive to changing circumstances. Such forces can directly influence the critical vulnerabilities of an adversary, and CDs will have a role in maximizing the amphibious warfare capability. Submarines will contribute essential reconnaissance and surveillance information as well as interdicting hostile maritime forces sent to interfere with operations. Mine warfare and clearance diving forces will have a vital role in ensuring freedom of manoeuvre, from conducting clandestine beach reconnaissance to the clearance of mines and obstacles in the beach approaches.

Australian commandos

Australian commandos work alongside the clearance divers on maritime operations, particularly the 2nd Commando Regiment, which is a special forces unit of the Australian Army and is part of Special Operations Command (SOCOMD).

The role of the regiment is to conduct large-scale offensive, support and recovery operations beyond the scope and capability of other ADF units. The role of the commandos is to span the gap between conventional infantry operations and unconventional operations, and the unit was formed to complement the Special Air Service Regiment (SASR). The commando regiment is designed to be a self-contained, flexible and rapidly deployable force, and is structured for both special operations and domestic counterterrorism.

Number 1 Commando Regiment is part of the Australian Army Special Operations Command (SOCOMD), and is a reserve unit serving on a part-time basis. As such it fills a unique role in providing a surge capacity to the overall commando capability managed by full-time professional staff. They exercise with the Australian Navy clearance divers in the maritime anti-terrorist role and can be called on when required.

The UK

Special Boat Service

United Kingdom Special Forces (UKSF) group is a directorate of the UK Ministry of Defence (MOD) and is commanded by a Director Special Forces (DSF), usually of brigadier rank. UKSF was established in 1987 so as to bring all UK special forces under a single command structure. Since 2011, UKSF has been a component of the Joint Forces Command (JFC). The establishment of UKSF was intended, amongst other things, to improve cooperation between the SBS and the SAS. At the time there was much debate that the SBS would just be integrated into the SAS, but the Royal Navy fought its corner and the two remain separate. There remains much speculation that a merger between the two units will happen at some point in the future.

On 18 November 2003, the SBS were given their own cap badge comprising Excalibur piercing the waves, with the motto ‘By Strength and Guile’, set on a black shield. The SBS is a tri-Service unit which means that selection is open to all arms of the military. However, the wearing of the green beret links the unit to the Royal Marines Commando, where the majority of the unit comes from, and which is already considered an elite force.

The Special Boat Service is based in Poole, Dorset, on the south coast of England, and has around 250 swimmer canoeists divided into four squadrons: C, X, M and Z.

With a foundation in diving, new members in the SBS will strive to become expert divers and learn the skills of exit and re-entry of a submerged submarine. This allows the SBS divers to exit the sub while it remains hidden, and take their equipment up to the surface before proceeding with the mission. Once the mission is complete, the SBS divers dive back down to the submarine and re-enter. This technique is dangerous as well as time-consuming but allows for a highly clandestine mission.

SBS divers are trained to swim into harbours to examine and photograph the underside of enemy vessels to reveal information about the onboard sensors and engines. This can be a highly dangerous pursuit if against a proficient enemy as they will carry out anti-diver drills such as sending down their own divers, turning the propellers or emitting sonar waves.

Another longstanding task for the SBS is to thoroughly survey the beaches and approaches to the landing area prior to an amphibious assault. SBS divers use a variety of tools to measure the incline of the seabed and to test its consistency and suitability for landing craft. This task may not be glamorous but it does require high levels of stamina and concentration. Throughout the years, the SBS has clandestinely reconnoitred many potential landing points around the world.

The importance of this is to identify if there are any beach obstacles such as tank traps or landing craft obstructions that might have to be demolished. The SBS divers are skilled at setting charges while remaining submerged and out of sight. Examples include where SBS teams secured the beachheads of the Al Faw Peninsula at the start of Gulf War II, and carried out beach surveys prior to the main landings at San Carlos during the 1982 Falklands conflict.

The canoe is still a key tool in the SBS equipment inventory and provides transport for covert infiltrations. (MILpictures by Tom Weber/Getty Images)

A member of the SBS surveying a beach to determine the suitability as an amphibious landing option. (Royal Navy)

Parachuting is an accepted form of infiltration, and the SBS were the first unit to develop techniques for parachuting men and equipment into the sea. Called 'wet jumping', it allows the SBS to drop a large maritime counterterrorism force or raiding party far out to sea, out of sight of the enemy. Rigid inflatable boats (RIBs) are dropped first, followed by the men, who quickly swim to the boats and attach outboard motors.

HALO, as the name implies, involves jumping from a very high altitude – 9,000m or higher – only opening the chute at the last moment. The idea is to exit the plane, at night, above visual range of enemy on the ground and then open the chutes at low altitude, thus minimizing the time spent suspended below a slowly descending canopy. The jumper has to wear oxygen breathing apparatus as the air is too thin at high altitudes. Keeping a stable free-fall posture while laden down with a bergen (backpack), oxygen bottles and weapon strapped to one's back requires great skill.

HAHO requires the jumper to open their chute straight away then glide to the landing zone (LZ). While this technique is less stealthy than HALO, it has the advantage that the jumper can glide up to 50km from the drop-off point. This stand-off capability means that HAHO jumpers can glide across borders, while the mother-plane stays in friendly airspace. As with HALO, the jumpers must wear breathing gear for much of the descent. Navigation skills must be sharp to allow the jumper to glide their steerable chutes to the right LZ.

Parachuting is becoming an issue with regard to the proliferation of radar systems that can detect the plane and the parachutists, so there is a preference to use helicopters for insertion (see Chapter 9 on infiltration options). Submarines have long been used by the SBS and that option has been enhanced with the Astute class of submarine, with the option of them being fitted with dry deck shelters to transport the new MK 11 Shallow Water Combat Submersibles (SWCS) (see Chapter 12 for detail on the MK 11). This will take the SBS to another level in terms of combat diver capability.

A badge depicting the Royal Navy divers. (Author's Collection)

Royal Navy clearance divers

The Royal Navy's ship's diver (previously known as the shallow water diver or ship's diver) was from any rank or specialization, and was trained to use self-contained open-circuit compressed-air diving apparatus. The part-time divers could search a ship's hull for explosive devices or perform simple underwater engineering tasks, but they were replaced by clearance divers in the mid-2000s. Clearance divers have been the Royal Navy's specialist trained divers since World War II, and form the diving elite within the Navy. They are trained to use all types of service diving equipment, including surface demand and closed-circuit mixed-gas breathing apparatus to perform deeper diving. Their skills include explosive ordnance reconnaissance (EOR), explosive ordnance disposal (EOD), salvage operations, and complex underwater engineering tasks.

Royal Navy Fleet Diving Group

The mine clearance divers of the Fleet Diving Group (RN FDG), Fleet Diving Squadron (FDS), are an elite cadre of combat divers who provide EOD support to the Special Forces and Royal Marines, locating and neutralizing mines and IEDs in the water and on land. The Fleet Diving Group deploys divers around the world, as needed. It is based at Fleet Diving Squadron Headquarters, Horsea Island, Portsmouth. The group consists of three Fleet Diving Units (FDU), each led by a Royal Navy lieutenant.

Fleet Diving Unit 1

FDU1 provides support to United Kingdom Special Forces (UKSF). FDU1 divers neutralize any explosive threats during SBS/SAS Maritime Counter Terrorism (MCT) operations. The unit maintains a very high state of readiness.

The role includes assault improvised explosive device disposal (AIEDD), which maintains the momentum of an operation by rapidly marking and clearing any IEDs from the path of an assault force. The assault IED operators may need to disarm explosives that deny access to structures and routes, or devices attached to hostages.

FDU1 divers train for maritime counterterrorist operations on oil rigs, ships (both under way and in port), as well as on land. They are trained in various insertion techniques such as by small boat, submarine or by parachute, including wet drops, HALO, HAHO and tandem.

Specialists from FDU1 also support the SBS by providing training and operational support for submarine-related activities. This support includes the provision of navy caisson divers who remain with the submarine to assist

A Royal Navy clearance diver using a surface supplied hard helmet diving system. The diver fits a neck dam which seals around the neck and rests on the shoulders, to which the helmet is fitted. The diver is dressed in a dry suit, and the umbilical provides the breathing gas. There is an emergency bail out bottle and CCTV camera. The diver can remain at depth for longer periods dependent on depth, time and decompression profile. (Photo by Jeff J Mitchell/ Getty Images)

at the Special Forces Payload Bay or Dry Deck Shelter, which attaches to Astute-class subs and is used to launch and recover SBS divers and swimmer delivery vehicles.

Fleet Diving Unit 2

FDU2 specializes in very shallow water (VSW) mine clearance operations in support of UK and NATO deployments. Their role includes carrying out beach reconnaissance ahead of 3 Commando Brigade amphibious landings. Following a covert over-the-horizon transit via small boat, FDU2 divers are trained to slip into the water and infiltrate into the target area, operating into the shallow waters, up to the surf zone. Such beach recces are likely to be undertaken alongside 539 Assault Squadron Reconnaissance, Royal Marines whose role is to perform beach reconnaissance ahead of an Amphibious Task Group landing. A six-man Squadron Recce Team uses various methods for inserting onto a beach but are not diver trained. The FDU2 divers can use unmanned underwater vehicles (UUVs) to check for mines in the boat lanes leading to the proposed landing site. If required, they can leave the surf and sweep the beach itself for mines, and any that are detected can be wired for demolition – to be detonated just ahead of the arrival of the landing force. The unit can also carry out searches for IEDs placed on port infrastructure and close to, in, and under ships.

Fleet Diving Group 3

FDU3 operate mainly in the mine investigation exploration (MIE) and underwater force protection (UWFO) role. They are trained to check for

mines in ports, including under ships' hulls and in deep waters. They also undertake battle damage assessment and repair (BDA/BDR) operations across the fleet. This role may include supporting post-assault operations in clearing any remaining ordnance.

Fleet Diving Unit divers are equipped with the Stealth CDLSE (Clearance Divers' Life Support Equipment) diving sets, which are closed-circuit, electronically controlled mixed-gas rebreathers. The CDLSE set is made from non-magnetic materials – an important feature for mine clearance divers – and can use air, heliox or trimix. The CDLSE goes over a neoprene dry suit with non-magnetic zips and inflation valves, made by Northern Diver.

The Northern and Southern Diving Groups

The Northern Diving Group (NDG) includes 40 Royal Navy Clearance Divers and their specialist support staff. Military aid to civil authorities (MACA) is the team's most frequent responsibility. Responsibility starts at the high-water mark in Liverpool, up to the Orkneys, clockwise around to Hull, including day-to-day dockyard assistance at Faslane, and underwater security for submarines as they come in and out of the base. NDG provides a team at 48-hours' notice to support the NATO Submarine Rescue System.

Able Seaman Diver Phil Barham waits for his dive-buddy to enter the water during a United States/ United Kingdom Mine Countermeasures Exercise. (US Navy photo by Mass Communication Specialist 3rd Class Jumar T. Balacy/ Released)

The British Army Royal Engineers have specialist combat divers who support the army on operations. (Photo by Oli Scarff/Getty Images)

Southern Diving Group comprises some 40 highly skilled Royal Navy Mine Clearance Divers, with their primary role to keep UK waters free from unexploded wartime ordnance. Despite their age, unexploded bombs and mines pose a serious threat to both the public and to critical national infrastructure. Southern Diving Group also carries out a range of more general duties, from water maintenance and repair to battle damage assessments.

Special Air Service boat troops

Much has been written in recent years about the Special Air Service, and the selection and training of its members has been covered in great depth. The SAS has long accepted the benefits of infiltration by water, and had its own Special Boat Squadron operating in the Aegean during World War II. This role was passed over to the Royal Marines when they took over all amphibious operations following the war. After disbandment the SAS was reformed for the Malaysian counterinsurgency campaign. Alongside the British SAS was the Australian, New Zealand and Rhodesian SAS – the latter subsequently disbanded.

In the British SAS each squadron has a boat troop who specialize in amphibious insertion via various small boats, and surface and underwater swimming. In the past the need for diving proved more difficult, as they

had no training facilities, nor anybody who could instruct them. They put men through the Army's diving school, which was geared to training engineer divers on open-circuit compressed air; however, this apparatus was not suitable for troopers on a covert underwater operation. The SAS turned to the Royal Navy for training in the use of the closed-circuit underwater breathing apparatus, which meant that they could infiltrate calm water areas using the 'no bubble discharge' system. This equipment is relatively light and durable for carrying on clandestine behind-the-lines operations, even if infiltration is by HALO parachuting.

The SAS make their amphibious role a part of their post-selection specialization, and each squadron's boat troop is usually made up of 16 men, trained to use water as a means to an end, for infiltration of enemy-held territory using small boats, canoes and combat divers.

Wet parachute drops have become an accepted practice, and they also utilize the Navy's submarines for transporting teams to a target area, where they then use canoes or small boats to reach land, or penetrate up-river to an inland target. They can make good use of lakes and rivers for movement and concealment.

A possible problem for the SAS in the amphibious role is the continuous training and maintenance of equipment associated with water operations, and the Regiment's overall commitments in other areas. When the boat troops are suddenly provided with a task they may encounter problems, such as those experienced in the South Atlantic with failure of outdated outboard engines. The Regiment has overcome equipment problems in the past, and will rectify any deficiencies found, all aided by the cross-training and transfer of information with other allied special forces.

The Australian SASR (They add the R onto SAS as an identification mark) have a long-range reconnaissance role, operating in small patrols of five or six operators, with the task of infiltrating enemy-held territory and providing intelligence on enemy activities and capabilities. During such tasks the SASR seeks to evade rather than confront the enemy. Each squadron has a boat troop, allowing them water operations and use of small boats and canoes, as well as deployment from submarines. Each Sabre Squadron then has four company-sized troops comprising about 100 personnel, and an additional 16-person HQ. The boat troop has an eight-man troop HQ section and 24 operational personnel. In addition to the other skills, boat troop specializes in small craft handling, surface swimming, diving using closed-circuit breathing apparatus, and maritime operations.

The New Zealand Special Air Service's (NZ SAS) key roles are to undertake overseas missions and respond to domestic terrorist attacks. Their selection process is modelled on the other units and the same beret, badge and motto is adopted. A and B squadrons each have a boat troop who are specialists in small craft handling, surface swimming, diving using closed-circuit breathing apparatus, and maritime operations.

Underwater Bomb Disposal

A notable piece of ordnance disposal was undertaken in 1970, off the Island of Jersey, by the Plymouth Command Clearance Diving Team. They were called to investigate the wreck of a German freighter, sunk by the RAF in World War II. It was the cargo that was of concern, for the vessel carried a variety of ordnance which had deteriorated over the years. More than 50 450kg bombs made up the cargo, and they were found to be rusty and almost unrecognizable. The corrosive effect of the sea had rendered the bombs, primers and detonators very unstable. For the Navy's clearance divers it was just another job, and the fact that the sea conditions were poor, with both a heavy swell and virtually no visibility, was quite normal. One added problem was the leakage of iron pyrites from the primers; this is a volatile substance and therefore extremely dangerous, since the slightest knock or even temperature change can cause detonation.

The disposal operation was to be divided into two parts, with the first lasting five weeks. The initial survey determined the condition of both vessel and bombs, and from this the plan of action was drawn. Care had to be taken, as the lives of the divers and of civilians, some one and a half miles away on the small island of St Helier, were at risk. Some of the divers would no doubt have commented that their own lives were probably a long way down the list of priorities.

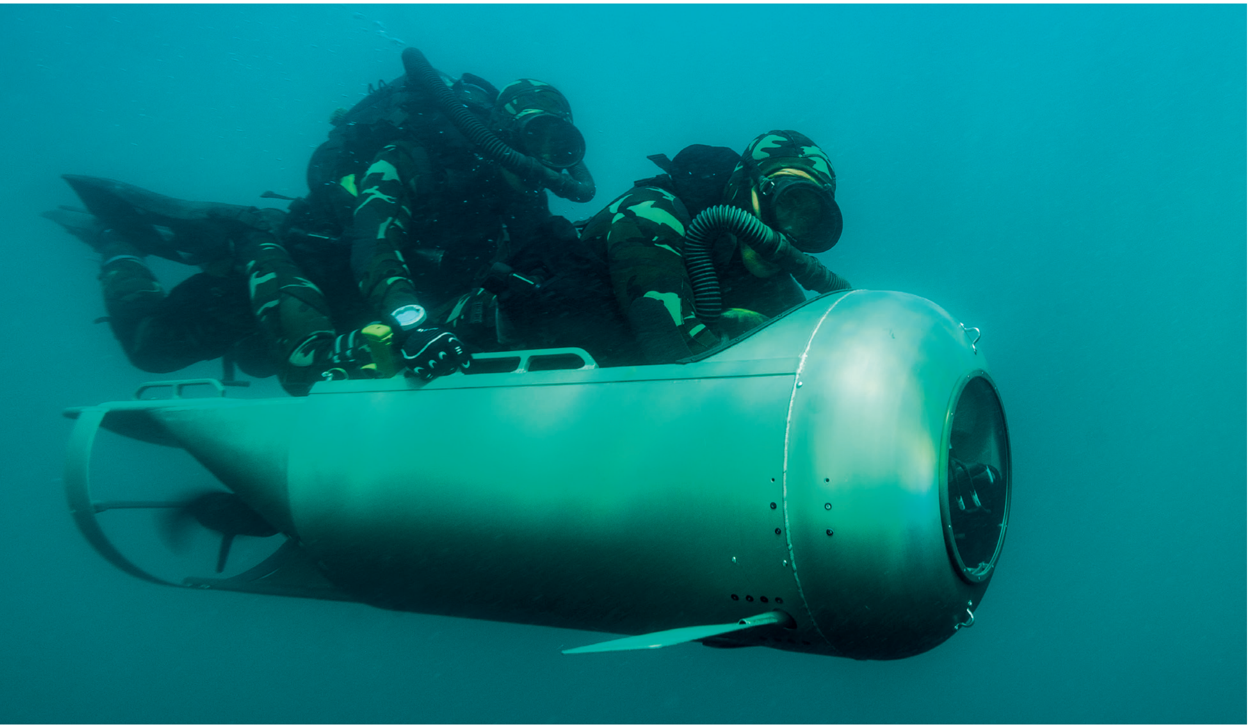
The heavy swell created by Atlantic gales hampered operations. The depth in which they worked ranged between 12m at low tide to 21m at high tide. They used both wet and dry suits, and the Clearance Divers Breathing Apparatus, with an oxygen and nitrogen breathing gas. They dived at the turn of tides, for one hour at low water and 40 minutes at high water. They had to work quickly and efficiently, for time was not on their side. The efforts during this phase resulted in the raising of 23 bombs, which were lifted individually, taken aboard the diving vessel, and further out to sea, where they could be detonated safely.

Phase two was not going to be so easy, for amid the tangled wreckage of the ship's hold were about 15 bombs too dangerous to be moved. They would have to be detonated in such a manner as to cause as few shock waves as possible. The charges had to be placed by divers entering the hold amidst the twisted jagged steel. With the work done, the area was cleared and the charges detonated. For those on land it was an anti-climax, since the ground shock was minimal and there was no air blast to create a loud bang. For the clearance divers it was a successful completion to a difficult job, earning them a commendation. For the islanders, especially the inhabitants of St Helier, there was satisfaction at the removal of thousands of kilograms of TNT.

France

Commandos Marine

The Commandos Marine are a unit of special forces that operate under the Naval Rifle and Special Forces Command, as well as the Special Operations Command. Candidates who wish to enter the modern Naval Commandos



ABOVE
Two combat swimmers of the French Commando Hubert move through the water to a target aboard their two-diver underwater propulsion device. (Photo by Alexis Rosenfeld/Getty Images)

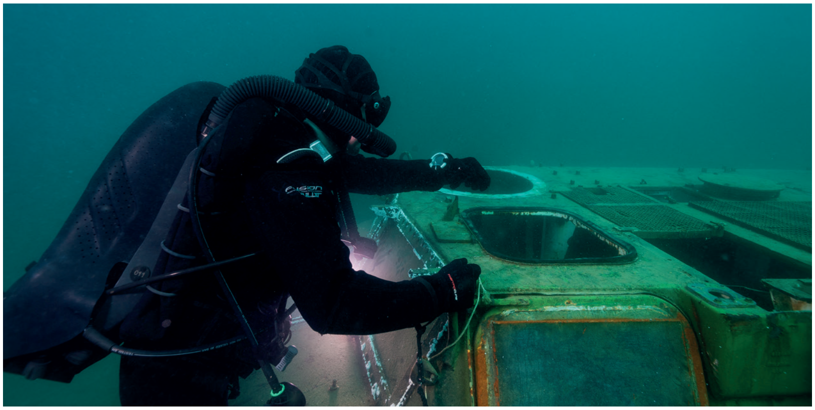
PREVIOUS PAGES
Two combat diver snipers from the French Commando Hubert swim ashore with equipment in sealed bag. (Photo by Alexis Rosenfeld/ Getty Images)

must be Fusiliers Marins with at least nine months' service. What they enter is widely regarded as one of the toughest courses in NATO special operations forces.

Commando Hubert is a combat swimmer unit assigned to the French Navy's Commandement des Fusiliers Marins Commandos (COFUSCO). The unit is tasked with conducting maritime special operations in support of the French Navy and intelligence services, primarily the DGSE (the French foreign intelligence directorate).

Currently Commando Hubert is composed of 80 men divided into two companies. The first company consists of 50 men and is subdivided into four sections designated A, B, C and D (plus the proposed E section):

- A section is the command and support section. It contains the unit HQ, and the unit's Hurricane RIBs.
- B section is the maritime counterterrorism (CT) section. The unit specializes in conducting underwater approaches to terrorist targets. They conduct joint operations with the Navy's specialist units and the French GIGN, the elite tactical unit of the French National Gendarmerie, which has combat divers within its ranks.
- In the event an assault was ordered on a target at sea, B section divers would act as guides for the GIGN team.



LEFT
Two combat swimmers of the French Commando Hubert using diver underwater propulsion devices; one is fitted with navigation equipment. (Photo by Alexis Rosenfeld/Getty Images)

BELOW LEFT
A combat diver from the French Commando Hubert carries out a mine clearance diving exercise. (Photo by Alexis Rosenfeld/Getty Images)

- C section is the SDV section. Its divers receive additional training in the use and maintenance of swimmer delivery vehicles.
- D section contains the unit's snipers and heavy weapons experts. It is responsible for performing beach reconnaissance, shipping attacks and underwater demolition operations, providing heavy fire support, and testing new equipment for use by the unit. All members of D section are both HAHO and HALO qualified.
- The proposed E section will consist of the Hurricane RIBs, small boats, and support personnel drawn from the 2nd Company. The 2nd Company is a support unit made up of 30 men. Men are assigned to one of the company's teams which specialize in communications, SDV maintenance, logistics, or small boat operation and repair. The unit also has a French Naval vessel, the *Poseidon*, set aside for its exclusive use. The ship acts as a floating base of operations and as an insertion vehicle for both divers and SDVs.

The 2nd French Foreign Legion Parachute Regiment (2nd REP)

An elite combat diver unit is found within the 2nd French Foreign Legion Parachute Regiment which is based at Camp Raffalli near the town of Calvi on the island of Corsica, south of mainland France. The regiment only takes the best of the newly trained recruits that it requires to meet its complement. The 2nd REP has six combat companies trained in different military specialities: urban warfare, mountain warfare, amphibious warfare, explosives use, desert warfare and a heavy weapons company.

The 3rd Company specializes in amphibious warfare – it comprises five officers, 23 non-commissioned officers and 123 legionaries, and is divided into three combat sections and a support section. There is a combat diver section, a boat section and a landing section. If the regiment is required to undertake an

BELOW
The beret badge of the 2nd French Foreign Legion Parachute Regiment, which has a combat diver company within its ranks. (Author's Collection)

BELOW CENTRE
A canoe/diver team from the French Foreign Legion undertakes an infiltration mission into enemy territory. The team can multitask with a variety of weapons and night vision equipment, and would carry diving equipment. (Photo by José Nicolas/ Sygma via Getty Images)

amphibious operation, reconnaissance divers will recce the beach, supported by the boat section, with the landing section securing the landing area. They undertake wet parachute drops, operate from submarines and deploy in inflatable boats and canoes.

Located a few metres from the shore at Camp Raffalli is the amphibious centre of the 2nd REP and home to the 3rd Company, where it runs amphibious training courses. It also carries out the maintenance and storage of the amphibious equipment, such as the inflatable boats' outboard engines, and canoes.

Denmark

Frømandskorpset (Frogman Corps)

Frømandskorpset is part of the Danish Navy and provides an amphibious special forces unit. They serve as both combat swimmers and an assault unit, capable of conducting long-range reconnaissance and direct action, such as assaulting enemy ships, sabotage of fixed installations and counterterrorist operations.

Volunteers generally come from the Navy, but Army recruits can apply provided they are recommended. The nine-month selection course has 500–600 applicants every year, with fewer than a dozen surviving the course. It is said that since its creation in 1957 only 311 individuals have completed the training and become a frogman.

The Danish frigate HDMS *Esbern Snare* was on deployment in the Gulf of Guinea in November 2021 when the captain received reports of an increased risk of piracy in the waters south of Nigeria. The frigate set course for the area of concern, which was in international waters, 25 to 30 nautical miles from Nigeria's territorial boundary. The ship's Seahawk helicopter was dispatched to carry out an aerial reconnaissance and gather any intelligence. They located a number of merchant ships and discovered a fast-moving boat. The helicopter crew counted nine men on board and could see equipment associated with piracy, including ladders, which are used to hook onto the side of a target ship to gain access; this added to their assessment that the men were suspicious and probably pirates and therefore warranted an inspection.

It was evening when HDMS *Esbern Snare* was close enough to deploy a boarding party formed by frogmen of the elite Danish Frømandskorpset, who used fast boats to undertake the operation. Closing in on the boat the frogmen called on the pirates to stop so that their boat could be boarded for inspection, but they refused and continued on their way. The frogmen fired warning shots but the response was for the pirates to return fire. There immediately ensued a gun battle in which four pirates were killed and one wounded, with the remainder ceasing their aggression before being taken to the warship to be detained. The outcome was that the pirates' boat sank. None of the frogmen

OPPOSITE BOTTOM LEFT
In the French Foreign Legion combat diving is a method used to reach a target, and once ashore they adapt to begin their on-land mission. (Photo by José Nicolas/Sygma via Getty Images)

OPPOSITE BOTTOM RIGHT
A member of the French Foreign Legion undertaking a surface swim, guiding equipment in bags. (Photo by José Nicolas/Sygma via Getty Images)

ABOVE
A member of Frømandskorpset comes ashore ready to engage any enemy forces. (Danish Armed Forces)

ABOVE RIGHT
A frogman swims ashore on the surface with a load of equipment. This type of infiltration would normally be undertaken at night. (Danish Armed Forces, Casper Tybjerg)

CENTRE RIGHT
Members of Frømandskorpset undertake an endurance swim to the beach. Selection and training is tough with a high failure rate. (Danish Armed Forces, Thomas R. Reiman)

BOTTOM RIGHT
The type of boat available to the Frømandskorpset is ideal for the interception of suspect vessels or deploying frogmen as it is fast and well-armed. (Danish Armed Forces, Henrik Palshøj)

Jægerkorpset is a special forces unit where all volunteers undertake a three-week combat swimming course conducted by the Frømandskorpset. (Jeppe Gustafsson / Alamy Stock Photo)

were injured, which is testament to the training, equipment and professionalism of one of the world's elite frogmen units. (For more on the handling of piracy, see Chapter 10.)

Jægerkorpset (Jaeger Corps)

The Jægerkorpset is an elite special forces unit within the Danish Defence Special Operations Command, with a primary role of reconnaissance and observation. Following the events of 9/11 the Jaegers evolved to meet the developing threat of global terrorism while maintaining their original role. In 2002 the Jaegers were deployed to Afghanistan as part of the Danish contribution, alongside Frømandskorpset. During these operations the Jaegers took part in reconnaissance, observation, capturing of high-value targets and direct-action raids. As part of their role all volunteers undertake a three-week combat swimming course conducted by the Frømandskorpset.

Germany

Kommando Spezialkräfte Marine (KSM)

The elite detachment of combat divers, Kommando Spezialkräfte Marine (KSM) – Kampfschwimmer (Combat Swimmers), is a special unit within the German Navy, which has been established solely for the purpose of specialist underwater diver operations. In 2014, as part of a major reorganization across the German military, the naval commandos split up into independent organizations. The combat divers based at Eckernförde became the KSM, and are now totally responsible for handling their own selection, ongoing training, logistics and operations. The Bundeswehr states that the unit advertises for, selects and trains all of its operators.

TOP
A canoe pair with the operative in bow ready to dive while also ready to engage the enemy. The other operative controls the canoe and will remain in it when the combat diver enters the water. (Photo by Alexander Koerner/Getty Images)

ABOVE
Kommando Spezialkräfte Marine – Kampfschwimmer badge. (Author's Collection)

I was in contact with a member of the unit regarding a contribution to this book when communication abruptly ceased. This was not unusual, as dealing with a secret operational unit can be challenging and this instance is just one of a number. I then made contact with an individual who had been called in to temporarily take over the communications role. All operational members of the unit had gone operational, hence the radio silence. This unit is both interesting and important in that it is a stand-alone special force with responsibility for its own destiny.

The tasks of KSM include reconnaissance and sabotage activities above and below the water, and in the coastal zone. Their missions extend to protecting and ensuring the security of any ships, and oil and gas offshore platforms. The KSM regularly trains with the US Navy SEALs, a cooperation that dates back around 40 years. At any time, at least one SEAL instructor embeds with the KSM, in exchange for a German diver. They also maintain close ties with the French Navy's combat divers, Commando Hubert.

An operational team will generally comprise four or five combat divers – a commander, a sniper, a medic, a radio operator and an observer. They use the German rebreather Dräger LAR-V, and have the option to select drysuits and wetsuits, fins and masks, knives, underwater watch, and navigation swim boards. In addition to the Heckler & Koch range of conventional weapons, they have the P11 underwater pistol, which fires steel darts. Diver propulsion craft are used for underwater movement, and there is a wide range of surface craft, including canoes.

ABOVE
Combat divers generally work in pairs and when leaving the water are ready to engage the enemy should they be spotted. This image shows them close together, which creates a large target, so on an operation they would have space between them but still be able to communicate. (Photo by Alexander Koerner/Getty Images)

LEFT
Line of sight navigation means that the divers can see a target point and set the compass bearing on it, which they submerge and follow. This is a skill taught to all combat divers. (Photo by Alexander Koerner/Getty Images)

Through inter-service cooperation they have access to surface warships, submarines, fixed-wing aircraft, and helicopters for training and operations. The unit is supported by special operations boat teams and maritime mobile medical teams. It is accepted that only 30 percent of volunteers seeking to join the unit are successful. The complement of divers in the unit is not divulged, but is said to number about 250 men with about 40 men actively operational. The operational requirement will depend on the status of the threat level and need for special forces combat divers.

ABOVE
This image shows a diver who has the breathing system mouthpiece in place and who is wearing a face mask while on land looking at the operative in the canoe. (Photo by Alexander Koerner/ Getty Images)

TOP RIGHT
Two combat divers using camouflaged body covering, helmets and weapons come ashore. One diver provides defensive cover while the other has a task to complete. (Photo: Carsten Rehder/ dpa picture alliance / Alamy Stock Photo)

ABOVE RIGHT
A German combat diver climbs out of the water having undertaking a pool training session. Using the breathing equipment becomes second nature with automatic reactions to its use. (imageBROKER / Alamy Stock Photo)

Singapore

Naval diving unit

Singapore is a small country at the tip of Malaysia, famed for its business sector, global trading, and as a first-class tourist destination. The maritime trade has been a key component of Singapore's economy and vital to its survival and prosperity. With Singapore's strategic location, and seaborne trade being crucial to the economy, there is immense reliance on the sea to import valuable cargo and energy, and to export manufactured goods. As part of securing the freedom of the seas for trade, the Republic of Singapore Navy is a pivotal component, with its unit part of the maritime special forces unit. While Singapore has one of the busiest ports in the world, the offshore islands along the Singapore Strait have some of the world's largest oil refineries, so threats to Singapore's waters are a major defence factor.

FAR LEFT
Singapore Special Forces combat divers are infiltrated by helicopter as part of an anti-terrorist rapid response operation. (Photo by Jonathan Drake/Bloomberg via Getty Images)

LEFT
A Singapore Special Forces combat diver preparing to recover an explosive device. Gaining experience in the controlled conditions of a pool will help when undertaking the operations in difficult water conditions. (ROSLAN RAHMAN/AFP via Getty Images)

ABOVE
A Singapore combat diver deploys from a low flying Chinook helicopter as part of a team deployment. (ROSLAN RAHMAN/AFP via Getty Images)

The organization has three elements: a Special Warfare Group for commando and diver warfare; Clearance Diving Group for underwater ordnance disposal; and Underwater Demolition Group for salvage operations.

Naval divers in the Special Warfare Group are elite soldiers, trained to operate at sea, on land, and in the air, and are armed with advanced weaponry. They are also part of Sea Security Teams who board and search ships that carry highly sensitive materials.

Bangladeshi Combat Diver Strikes

The Mukti Bahini, also known as the Bangladesh Forces, was a guerrilla resistance movement consisting of the Bangladeshi military, paramilitary and civilians during the War of Liberation that transformed East Pakistan into Bangladesh in 1971. The Mukti Bahini frogmen were grouped in four task forces, which were in turn divided into teams of three divers armed with neutrally buoyant limpet mines, one grenade, a knife, swimming fins and a wrist compass.

The first coordinated attack by divers occurred on the night of 15/16 August 1971 against a number of ports. For the attack on the major port of Chittagong three groups sauntered into the port in pairs in broad daylight to reconnoitre the target area with the limpet mines and fins hidden in baskets of jackfruit which they carried on their heads. Target vessels were then assigned to each pair and the group moved out of the port and upstream where they waited until midnight, to coincide with the beginning of the ebb tide and also a change of shift for the dock workers, before starting the attack.

At the appointed time they put on their swimming fins, entered the cold murky waters at agreed intervals and, using bamboo reeds in their mouths as snorkels, they floated downstream with the ebb current, keeping as low as possible in the water. Two frogmen took a deep breath and swam to the middle of a vessel and attached limpet mines with magnets to the port side of the hull, adjacent to the engine room and just below the waterline. The other pair also attached limpet mines to the starboard side of the freighter, after which both pairs swam downstream past the docks and escaped inland. The soluble plugs dissolved in about 30 to 40 minutes and activated the limpet charges, leaving the Pakistani freighters *Al Abbas* and *Ohramzd* to settle on the bottom. Similar attacks were carried out on two coasters, one tug, one ferry boat and two harbour craft. Four other frogmen penetrated the security barriers at Chalna on the same night and attached four limpet mines to the 7,000-ton Somalian freighter SS *Lightning*, which resulted in the grounding of the vessel in the river.

Ukraine

Special Operations Forces combat divers

Prior to the fall of the Soviet Union in 1991, Ukraine was part of that empire as the Ukrainian Soviet Socialist Republic, but subsequently established itself as a free, independent country. The choice of freedom from Russian domination followed a referendum where more than 92 per cent of the electorate gave their support for independence, and there followed the election of its first national president in 1991. The Russians were not happy about these events as they considered the country to be Russian, so in 2014 they seized Crimea, and signed a treaty with the newly proclaimed Republic of

LEFT
A Ukrainian special forces combat diver enters the water while working with the US military in Odesa as part of a counter terror/piracy exercise in 2010. (ALEXEY KRAVTSOV/AFP via Getty Images)

BELOW LEFT
A Ukrainian combat diver using SCUBA jumps from the dock as part of a joint exercise with the US Navy. Another diver has just entered the water. (US Navy photo by Mass Communication Specialist 2nd Class Trey Fowler)

BELOW
A Ukrainian combat diver's equipment is checked prior to entering the water during training with the US Navy. (US Navy photo by Mass Communication Specialist 2nd Class Trey Fowler)

Crimea, allowing Crimea and its crucial Black Sea port of Sevastopol to join the Russian Federation. The UN responded to this invasion of another nation's sovereign territory by passing resolution 68/262 declaring that the action was invalid and determined that Crimea was indeed part of Ukraine. Russia was the only country to vote against the resolution, and as such it was not enforceable, and any attempts to pass enforceable resolutions in the UN were blocked by Russian vetoes.

The result was that Russia illegally took control of Crimea, and then to compound matters, in the Donetsk and Luhansk regions of Ukraine, a force of what are best described as Russian-backed mercenaries supported by so-called pro-Russian protesters seized government buildings and police stations in several cities and held unrecognized referendums. Unsurprisingly, this resulted in conflict between the Russian-held territory and Ukraine, which, for some years, had been moving towards becoming more Western orientated, a situation which no doubt prompted President Putin's actions. By 2016, Ukraine had joined the European Union Free Trade Area with the aim of modernizing and developing Ukraine's economy, governance and rule of law to EU standards, so as to gradually increase integration with the EU Internal Market. There was also talk of a possibility of the country joining NATO, but in 2022 Putin decided to take Ukraine back by force and launched a full-scale invasion which, at the time of writing, has already been marred by atrocities and potential war crimes.

When the Russian Federation illegally occupied Crimea in 2014 it had captured the home of the country's military diver training centre. Ukraine had lost an important part of its specialist military divers' equipment and training base, as well as some divers and instructors at a crucial time in the country's evolution. It would be fair to say that in 2014 the Ukrainian military was not in a good place. It was that year that the annexation of Crimea and the war in Donbas started, and the People's Project – which is a non-commercial and non-profit organization – was created to raise money in order to support a number of projects, one of which was focused on military divers. By October 2019 a separate Military Diving School was established in Odesa to train both army and navy divers of all ranks and specialties, including special operations, reconnaissance, sabotage, and search and rescue divers. When military divers are required the school will train them from funds raised by the people of Ukraine and others outside of the country. The team of experienced diving instructors of the School of Military Divers has continued training potential divers to meet the exacting standards of military diving and to continuously improve their skills.*

In 1991 Ukraine had inherited some Spetsnaz special forces units from the remnants of the Soviet Union, but needed time and financial resources to make

* https://www.peoplesproject.com/en/school-of-military-divers/

ABOVE LEFT

A Ukrainian combat diver climbs out of the water having completed a dive task. (US Navy photo by Mass Communications Specialist 2nd Class Damon Grosvenor/Released)

ABOVE

Ukrainian combat divers work with US divers as a training exercise for cooperation. The US divers have full face masks while the Ukrainians use a half mask and demand valve mouthpiece. (US Navy photo by Mass Communications Specialist 2nd Class Damon Grosvenor/Released)

LEFT

A Ukrainian combat diver liaises with a US combat diver as the two groups work together for joint training purposes. (US Navy photo by Mass Communication Specialist 2nd Class Trey Fowler)

BELOW

A Ukrainian combat diver on left trains with a US Diver in Ukraine prior to war. (US Navy photo by Mass Communications Specialist 2nd Class Damon Grosvenor/Released)

TOP

Ukrainian divers of the emergency rescue special forces unit of the SESU are pictured during the Azov Sea aquatorium cleaning works to remove objects from the sea that might cause harm, including explosive devices. (Dmytro Smolienko/ Ukrinform/Future Publishing via Getty Images)

ABOVE

Ukrainian special forces combat divers operate under the water, on the surface and on land, creating a formidable fighting force. (Photo by Mykola Tys/SOPA Images/LightRocket via Getty Images)

RIGHT

Combat diving is the initial insertion when the diver moves to the covert reconnaissance, demolition or sniping role. (Photo by Vasyl Shevchenko/Pacific Press/LightRocket via Getty Images)

the changes. As part of its evolution the Ukrainian Special Operations Command (SOCOM) was eventually established in December 2015. It was expanded to encompass four army special operations regiments; three navy special operations regiments; and two training centres. Its overall strength appears to be between 2,000 and 4,000 members. At time of writing, as Russian armed forces continue their invasion against Ukraine, information regarding the activities of the Ukrainian Special Operations Forces (SOF) is understandably scarce, but without doubt they will be playing a major role in the conflict.

The three naval special operations regiments are capable of undertaking on-land operations, but are focused on security in the Black Sea, with operations covering combat diving, special reconnaissance and underwater demolitions, as well as amphibious interventions. The 73rd Naval Special Purpose Center is home to each unit, which is some 300 strong, and composed of special operations companies and platoons, to include Combat Diving, Underwater Demolitions Unit, the Clearance Diver Unit, and the Reconnaissance Unit, with a Logistic Unit for support. A number of countries have been instrumental in supporting the formation of Ukraine's special forces units, including the US, UK, Canada, Denmark, Romania, Georgia, Israel, Sweden and Norway, who have enabled Ukrainian SOF to counter Russian special operations units in particular.*

Ukraine's Snake Island is a small but strategically important island near Odesa which was seized by Russia during the 2022 invasion of Ukraine. It was where a small force of defiant Ukrainian border guards refused to surrender to the Russians, who eventually took the island by force. It is alleged that Ukrainian special forces combat divers were trained by the Royal Marines' Special Boat Service in how to use specialist equipment, including underwater vehicles. It is claimed that the Poole-based SBS travelled to Ukraine to the 73rd Naval Special Purpose Centre to train the Ukrainian combat divers who led the Ukrainian forces in retaking the island.

Russian Federation

Russian combat divers have long played a significant role within the Russian military; although their Cold War technology, equipment and armament had to catch up with the West, it has evolved throughout the years and continues to do so. However, they were successful in this and Russian combat divers will have undoubtedly participated in the 2022 Ukrainian war. They will have carried out operations with Naval Infantry amphibious landings and activities at objectives such as Mariupol in the Sea of Azov, and Odesa in the Black Sea, Ukraine's largest sea port. As previously noted, the conflict began when Russia illegally annexed Crimea in 2014, and spread to the Donetsk and Luhansk enclaves,

* https://www.janes.com/defence-news/news-detail/ukraine-conflict-ukrainian-special-operations-forces-in-focus

which were occupied by pro-Russian separatist forces and mercenaries. Ukraine, as an independent country with a democratically elected government, would like the option to join the European Union and the western defensive alliance NATO, but Putin has decreed that it will not happen.

Following a build-up of Russian military forces close to Ukraine's border, it was on 24 February 2022 that President Putin ordered his military to invade and take control of Ukraine by overthrowing the legitimate government, and place it under a Russian dictatorship with Putin's puppets in control. The plan stalled as the Ukrainians did not welcome the invaders but fought to defend their homeland, and so it quickly became a World War II Nazi-style blitzkrieg of destroying everything and everybody who stood in the way. This soon created a wasteland of destruction that will take years to rebuild, leaving millions of civilians dead or displaced. Putin threatened the world that any interference with his mission could result in what amounts to a nuclear war, and other non-aligned countries close to Russia's border, such as Sweden and Finland, could suffer similar consequences if they attempt to join NATO.

The war has provided an insight into the performance of the Russian military, although there is no evidence at the time of writing to judge any combat diver actions. The Russians had military superiority in the air, on the ground and at sea, but Putin and his generals, in their arrogance and incompetence, completely misjudged the situation. The Russian Federation Ministry of Defence has long portrayed their military as being a formidable force, but the reality in Ukraine shows a very different picture. The world has seen the Russian assault virtually halted, their soldiers surrendering and armoured columns obliterated, while bombs and missiles target nuclear plants. They have also targeted strikes on hospitals, schools, fleeing refugees and residential areas, with terror tactics used against vulnerable civilians including women, children and the elderly.

Oleg Yegorov was the author of an article titled, 'Deadly Dolphins: The story of frogmen in the Soviet special forces' from 11 October 2017. It provides an insight into Soviet/Russian special forces divers on a mission in the Barents Sea from a Russian perspective. The Dolphin unit was formed of Soviet frogmen after the start of World War II and played an important part in the ultimate defeat of both Germany and Japan. Thereafter, the Dolphins were involved in covert operations during the Cold War period and were provided with up-to-date equipment, including APS underwater rifles and SPP underwater pistols. The Dolphins also had special Piranha submarines (see Chapter 13) which could transport frogmen up to 1,000 miles, acting without assistance for up to ten days. The Dolphin unit was only dissolved in the 1990s after the collapse of the USSR. However, the skills of the military frogmen have not been completely lost as all personnel, with their specialized techniques, are now utilized in various different units of the Russian special forces, primarily Spetsnaz.

Yegorov describes a Dolphin operation in dramatic terms:

> Imagine you are on a mission to blow up a naval base of your adversaries. You skydive into the sea, with the aid of a parachute, 30 kilometers off the coast. You might find yourself in the middle of a terrible storm, but it doesn't matter – the only thing that matters is the task ahead of you. You swim, passing naval mines, signal cables and other traps. You are in constant danger. Beneath you is the black abyss of the sea, above you are floodlights and well-armed guards looking out from the coast. Your load is heavy and the chances of failure, and even death, are great. Sound scary?

Yegorov explains that for what he describes as the 'underwater super-soldiers' such a mission would not be such a terrifying prospect as they were well-prepared for this type of mission The training provided was truly excellent, even by military standards. For seven weeks cadets slept for only three or four hours each day, the remainder of which was taken up with 15 hours of study as well as hardcore physical exercise.

Yegorov makes the point that:

> It goes without saying that it will involve harsh training – the Dolphins needed to be able to survive in almost inhuman conditions. So, of course, not just anyone can make it into this unit. Out of twenty cadets, only one will make it past this initial phase of training. However, this is just the beginning.
>
> During the next phase (of 11 weeks) you will learn to fight using any weapon and even without any weapon at all. You will learn how to drive different types of vehicles, how to parachute, mine and climb. You and your fellow cadets will form groups of twos, three and four during this phase. Your groups will learn to exchange small commands that will enable you to act together like a one-piece mechanism. This level of cooperation will be an absolute must on any mission. The last phase continues for eight weeks. During this time, you must pass through training on different naval bases and learn how to act in specific territories. Frogmen each have different regions they specialize in, such as Latin America, North America, Southeast Asia, the Middle East and so on. The interests of the Soviet motherland must be protected everywhere!

Spetsnaz combat divers

The Dolphin unit as described above was under the Directorate of the GRU (the main Russian Intelligence Directorate), as were, and are, the Voyska Spetsial' Nogo Nazrachenniya, more commonly known as the Spetsnaz.

ABOVE
Soviet combat divers closed-circuit diving apparatus of the 1950/60s. At that time they were well behind in equipment design. (Author's Collection)

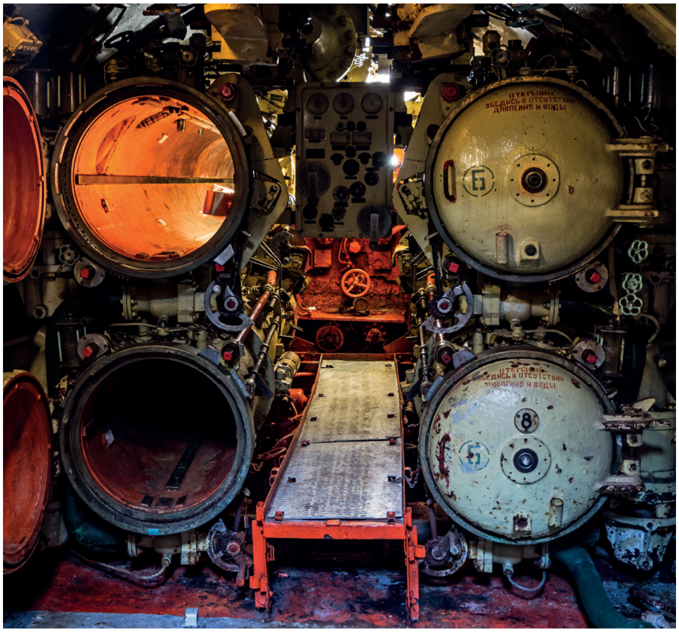
ABOVE RIGHT
A Russian combat diver equipped with a closed-circuit breathing system and carrying an APS DM underwater assault rifle of 5.66mm calibre that fires 250 rounds per minute at underwater targets at 30ft (9m). Note the large magazine. (Russian Federation Ministry of Defence)

Under the USSR structure there was at least one Naval Spetsnaz Brigade assigned to every Russian Fleet and there is nothing to suggest that this is not still the case, as they will meet the military demands both at home and abroad. The Naval Spetsnaz Brigade comprises a Headquarters Company, which encompasses the planning, training and intelligence-gathering units; Midget Submarine Group, trained to pilot and maintain the fleet of covert swimmer delivery vehicles; and three Combat Swimmer Battalions, which provide the covert swimmers, whose role includes amphibious assault support to mini-submarine raids and intelligence gathering.

Within the Spetsnaz Brigade, the swimmer battalions are subdivided into small units when assigned to operations with mini-submarines and the larger parent submarines for covert operations, as well as the amphibious-landing task groups. They also use parachute techniques to infiltrate into the waters of enemy territory, so as to undertake intelligence gathering and raids, and support amphibious landing. They have the option of low-altitude static-line parachuting, or the HALO (free fall) techniques, as the Spetsnaz divers are trained in HALO infiltration methods.

The selection and training for the 'Black Berets', as the Spetsnaz are nicknamed, remains tough even by Russian standards, and was backed by intensive political indoctrination, as they are given privileges not enjoyed by other military units. Today the old Soviet doctrine has been replaced by the Putin doctrine.

Spetsnaz divers can use parachute entry into the water, but that has some limitations as, once a mission is completed, the divers have to be extracted and, if using a surface vessel, there is more risk of exposure. From the exploits of



ABOVE LEFT
An inspection of Russian navy combat divers based in Syria. Russia often deploys special forces and ex-special forces into sensitive areas to deny their involvement should things go wrong. (Photo by MAXIME POPOV/AFP via Getty Images)

ABOVE
A Russian combat diver enters the water to begin an underwater search of ships using self-contained breathing apparatus. (PAUL J. RICHARDS/AFP via Getty Images)

LEFT
An example of opened torpedo tubes in the torpedo room of a Russian diesel-electric submarine (now a museum item) into which combat divers would climb and slide in. Then with pressure equalised they would be able to transfer out into the sea. The reverse procedure would be used to re-enter the submarine. (Photo by: Arterra/ Universal Images Group via Getty Images)

submarine and diver activities in Sweden, Spetsnaz have, and do use, conventional submarines and mini-subs which would provide a diver lock-out, lock-in capability. With the larger submarines it is interesting that the Russians use torpedo tubes as a method of diver exit and entry rather than a diver chamber built into the submarine. The torpedo tube could accommodate at least two divers but there would be no contact with those inside the boat should a diver have a problem with equipment during blow down. Tapping on the tube would possibly be the only option. An internal diver exit chamber could have communications between the divers and those on the boat, and could allow the divers to manage the flooding and water removal. The larger submarine could also surface and allow the divers to enter the water and use diver propulsion vehicles, or launch inflatable boats or canoes to progress a covert insertion.

Following the collapse of the USSR, the Naval Spetsnaz Brigades endured a period of neglect and subsequent loss of personnel, but the new Russia picked up where the Soviets left off, and use them to serve its purposes. Naval Spetsnaz Brigades can be tasked with using their combat divers for the reconnaissance of beaches, ports, harbours and potential landing sites for amphibious craft and helicopter landing zones. They can undertake pre-emptive strikes, such as attacking shipping or placing nuclear mines in enemy and neutral ports and waterways, as well as undertaking raids against onshore military or strategic targets, such as power stations and water reservoirs, following a covert infiltration from the sea.

Palestinian Dive Operatives

The *Jerusalem Post* reported on 8 June 2010: 'Naval Commandos Kill Gazan Frogmen':

'Commandos from the Israel Navy's Flotilla (Shayetet) shot and killed at least four Palestinian frogmen who were swimming out of Gaza on their way to attack targets in Israel. According to the Israeli Defence Force (IDF), the commandos had received prior intelligence regarding a possible infiltration and were in the area when they spotted the frogmen swimming out of Nahal Aza into the Mediterranean Sea. The Palestinians were carrying waterproof packages believed to be filled with weaponry. The troops opened fire after calls to stop were ignored, and four terrorists were killed in the ensuing gunfight. Another Palestinian, who was on a nearby boat guiding the divers, was reportedly wounded.'

The IDF further stated: 'The size of the unit and equipment it was carrying proved that a large attack had been thwarted.'

The Navy refused to disclose what was in the waterproof packages, but based on the way the frogmen were swimming, as well

Israel has an effective fleet of fast, well-armed patrol boats, which are able to support the country's combat diver operations while countering those of the enemy. (Evan Lang/Getty Images)

Frogmen of Saraya Al-Quds seen in Gaza, Palestine, with open-circuit breathing apparatus. The unit is used to attack targets including the State of Israel. (Photo by Ahmed Zakot/SOPA Images/LightRocket via Getty Images)

as the diving equipment they used, they had probably undergone extensive training for the operation.

This was not an isolated incident. Israel's Shin Bet domestic intelligence agency has identified that, during Israel's 2014 conflict with Hamas, members of the Hamas diver unit infiltrated Israel's Zikim beach before being attacked and killed by Israeli Defence Forces (IDF) defensive firepower. The *Algemeiner* stated in a headline on 3 August 2020: 'Hamas is Prioritizing Naval Attack Force Build-Up' and explains that the IDF recognizes that Hamas has strived to improve its diver unit's attach capability by expanding its rocket arsenal and ground forces. This will partly compensate for the loss of their ability to use tunnels to infiltrate Israel with armed killing squads. It also wants to improve its underwater attack capabilities. However, the Israeli Navy is responding to the threat by utilizing underwater sonar detection sensors and underwater depth charges and the Israelis have built a sea barrier on their southern coastline which has a high fence equipped with advanced sensors as well as an underwater wall of boulders.

Israel's coastline has sensitive targets such as power stations, while offshore natural gas drilling rigs form another potential target, and therefore there is a big advantage to be gained by using covert divers. Indeed, Hamas is known by the IDF Military Intelligence Directorate to be buying diving equipment and training its personnel as a matter of high priority.

The Philippines

The Philippines is an archipelago situated in South East Asia comprising about 7,640 islands, and covering a total area of around 300,000 square kilometres, making it the world's fifth-longest coastline. The country has valuable mineral deposits as a result of its complex geological structure, and is thought to have the second-largest gold deposits after South Africa. There are large copper deposits, and it is estimated to have the world's largest deposit of palladium. Other minerals include chromite, nickel and zinc.

Against this backdrop, the Philippine military – and particularly the Navy – have to guard against any unwanted intrusion. In the event that an island was captured and illegally held the Philippine maritime special forces would be required to infiltrate and gather intelligence, which would involve combat divers. They may also have to deal with sea mines that an invader lays to hinder naval counter operations. To deal with such an event, the Philippine special forces combat divers and EOD divers would need to react quickly, and that requires a pool of elite combat divers to be available. Indeed, the Philippines have one of the most extensive combat diver programmes in the world, as is detailed below.

Naval Special Operations Group

After a long operational history, the Naval Special Operations Group (NAVSOG) was separated from the Philippine Fleet and transformed to the Naval Special Operations Command (NAVSOCOM) on 7 July 2020. NAVSOCOM's mission is to organize, train, equip, maintain and deploy Naval Special Operations Forces for the conduct of naval, joint, combined and inter-agency operations in support of the Philippine naval missions. It is made up of: Sea-Air-Land (SEAL) Group; Special Boat Group; Explosive Ordnance Disposal Group; Naval Diving Group; Combat Service Support Group; Headquarters and Headquarters Support Unit; and Naval Special Operations Training and Doctrine Center.

SEAL Group's mission is to organize, train, equip, maintain and deploy SEAL and SEAL sniper teams for Special Operations Units in support to the NAVSOCOM mission.

Their capabilities are:

1. Conduct maritime operations:
   - HRVBSS (High Risk Visit, Board, Search & Seizure)
   - GOPLAT-T&R (Gas & Oil Platform Takedown and Retaking)
   - Harbour clearance and direct action
   - Sniper operations.
2. Conduct riverine operations:
   - Direct action
   - Special reconnaissance
   - Interdiction operations.
3. Conduct jungle operations:
   - Direct action
   - Special reconnaissance.
4. Conduct Urban Operations (MOUT):
   - Direct action (House – Building Assault and Raid)
   - Sniper operations.
5. Organize SEAL and SEAL sniper teams for deployment to Naval

Special Warfare Units (NSWUs).
6. Conduct SEAL and SEAL sniper operations refresher training.
7. Validate, develop and revise SEAL doctrines.

Special Boat Group's mission is to organize, train, equip, maintain and deploy Special Boat Teams for Naval Special Operations Units in support to the NAVSOCOM mission.

Their capabilities are:

1. Conduct support to SEAL, EOD and naval diving operations;
   - Insertion/extraction of SEAL teams
   - Interdiction operations
   - HRVBSS
   - CASEVAC and MEDEVAC
   - Diving and salvage platform
   - Search, rescue and recovery.
2. Conduct Special Boat operations refresher training.
3. Organize Special Boat teams for deployment to NSWUs.
4. Validate, develop and revise Special Boat doctrines.

Naval EOD Group's mission is to organize, train, equip, maintain and deploy Naval EOD teams for Naval Special Operations Units in support to the NAVSOCOM mission.

Their capabilities are:

- Conduct location; identification; evaluation; render safe; recovery; and transport & disposal of UXOs (unexploded ordinance), ERWs (explosive remnants of war), unserviceable ordnance and IEDs (improvised explosive devices) to include CBRNE (Chemical, Biological, Radiological, Nuclear, Explosives) and missiles
- Conduct post-blast analysis
- Conduct Underwater Mine Countermeasures (UMCM) or Clearance Diving
- Organize Explosive Ordnance Disposal teams for deployment to Naval Special Warfare Units
- Conduct CBRNE in support to special operations
- Conduct EOD operations refresher training
- Validate, develop and revise EOD doctrines
- Conduct Explosive Threat Security Survey.

Naval Diving Group's mission is to organize, train, equip, maintain and deploy naval diving teams for Naval Special Operations Units in support to the NAVSOCOM mission.

Their capabilities are:

- Conduct underwater search and rescue
- Conduct limited salvage and recovery
- Conduct limited ship husbandry
- Conduct hydrographic reconnaissance (admin)
- Conduct recompression chamber operations
- Organize naval diving and recompression chamber teams for deployment to naval special warfare units
- Conduct naval diving and recompression chamber operations refresher training
- Validate, develop and revise naval diving doctrines.

Combat Service Support Group's mission is to provide intelligence, communications, medical, and transportation support to the operations of the Naval Special Operations Units through Combat Service Support Teams in support to the NAVSOCOM mission.

Their capabilities are:

- Organize a composite grouping of forward CSS (combat service support) functional components in support to Naval Special Operations Units or independently deployed units
- Provide intelligence-liaising activities in support to the operations of the Naval Special Operations Units

Philippine combat divers deploy to the water as part of harbour clearance operation. They can use self-contained or closed-circuit breathing apparatus. (ROMEO GACAD/AFP via Getty Images)

Combat divers from Philippine Naval Special Operations Group (NAVSOG) jump from a helicopter as a method of rapid deployment. (TED ALJIBE/AFP via Getty Images)

- Provide communication link with Higher Headquarters, subordinate and adjacent units
- Provide Level 1 Echelon wheeled vehicle maintenance of the unit
- Provide motor transport to Command Headquarters, and other organic units
- Provide Level 3 Tactical Combat Casualty Care to the OPCON/ attached units
- Conduct/provide Ground Mobility Support; Communication Support; Logistics Support; Field Services; Engineering
- Organizational and intermediate-level motor maintenance support beyond supported units' organic capability
- Centralized ground supply support to include procurement, storage, care in storage, distribution and disposal.

Naval Special Operations Training and Doctrine Center's mission is to train and provide personnel with the necessary skills and knowledge in the conduct of Naval Special Operations in support to the NAVSOCOM mission.

Their capabilities are:

- Administer the conduct of basic, advanced and career specialization courses related to Naval Special Operations
- Develop and/or revise curriculum of Naval Special Operations-related courses
- Enhance the teaching proficiency level of instructors
- Assist in the formulation and/or revision of doctrines related to Naval Special Operations.

The Philippine Navy SEALs/combat divers have evolved from their traditional role within amphibious operations to become more specialized underwater

Philippine special forces combat divers are able to operate underwater, in the shallows and ashore. (ROMEO GACAD/AFP via Getty Images)

operators as they have expanded their role in both combat and non-combat operations. Historically, the role of combat diver focused on amphibious operations involving beach clearing for the landing of an amphibious assault force, and securing the littorals from enemy threats. This capability evolved as the need for special insertion techniques were required for operations in the archipelagic environment, such as that found in the Philippines. This meant that combat divers developed the capability to operate from the water to land operations in addition to operating from fixed-wing and rotary aircraft.

The new insertion techniques enabled the SEALs/combat divers to operate undetected in enemy-held territories, resulting in 'surprise', which is an essential principle of special operations. This capability was made possible with the acquisition of sophisticated diving equipment such as the Closed-Circuit Oxygen Underwater Breathing Apparatus (CCOUBA), combined with specialized training.

SEALs/combat divers could infiltrate underwater and undetected into hostile territory, either to conduct ship-boarding operations, Gas & Oil Platform (GOPLAT) recovery, ship attack, harbour clearance or the clearing of beach landing sites. This unique capability means that combat divers are able to conduct effective direct-action operations such as raids, ambushes and specific assaults.

This capability is also instrumental during other special operations missions such as Counter-Terrorism and Unconventional Warfare. NAVSOCOM enhanced this capability with the acquisition of Diver Propulsion Vehicles (DPVs). The US-manufactured STIDD will enable the operators to move swiftly and undetected, while carrying more equipment than when free swimming. Added to this is the proposed acquisition of submarines for the Philippine Navy, which will further enhance the SEALs'/combat divers' operational capabilities. Submarines are a prime mover of special forces divers, whether deploying the divers while on the surface or while submerged using the boat's submerged exit/entry options, such as torpedo tubes or lock-out chamber. The introduction of submarines would allow the Philippine Navy to conduct stealth operations, gather intelligence, and undertake surveillance and reconnaissance missions, as well as combat diver operations.

Combat divers wearing Closed-Circuit Oxygen Underwater Breathing Apparatus (CCOUBA). This is a training dive, as they are using a marker buoy. Note the diver on the right has a swim board with a compass and depth gauge fitted. They are signalling the OK sign to indicate that they are ready to dive. (Philippines NAVSOCOM)

CHAPTER SEVEN

FEMALE MILITARY DIVERS

Master Chief Mary Bonnin, US Navy

They are few in number but some female military operatives have qualified as combat divers. Master Chief Mary Bonnin earned her initial diving qualification in 1977, and graduated from the US Navy's First Class Diving School in 1981. She was the top of her class, receiving the Honour Person designation and became the first woman to qualify as a Diver First Class, defying those who thought she would not pass qualification. Indeed, one Chief Warrant Officer remarked to her at the very start of the process, 'You couldn't do it. Babe, what do you want to be a diver for? You'll be thrown out of that school in a week.'

During the seven years she spent as a Navy diving instructor, Master Chief Bonnin trained more than 1,000 divers, and in 1990 she earned the title of Master Diver – and remains the only woman in the US Navy to have done so. During her last tour she served as the leading naval diving safety authority. The Naval Undersea Museum in Keyport, Washington, has dedicated their meeting room as the Mary Bonnin room.

Considering the situation, she disclosed:

> I've never really felt that I did anything special and never really understood why some made such a big deal of the fact that I made Master Diver. I have always been frustrated that the female enlisted diving community has grown so slowly when I know there are so many talented enlisted women in the Navy. Hopefully with the new opportunities women have available, we will see more growth in the diving community.

Sergeant Stephanie Johnson, US Army

Being a young mother with two children to provide for is tough, but joining the US Army added to that toughness, and then becoming an army diver placed Stephanie Johnson as a woman with a mission. Qualifying to become a military diver requires a special determination for any volunteer, but Johnson took it all to another level when she became the only enlisted female diver in the Army.

Sgt Stephanie Johnson, a lead salvage diver with the US Army, wearing a surface supplied helmet ready to enter the water. (US Department of Defense, photo by Greg Sweney)

Johnson has always been interested in physical fitness and playing sports. Despite being fit, she found pull-ups to be challenging during Advanced Individual Training, and as she told Army.mil in March 2020:

> I had always worked out and I never really struggled, but building the initial upper body [strength], for me that was a huge challenge… I wasn't prepared for the level of physical training that dive school was going to take me to. Sometimes we were working out two or three times a day. I was just so tired all the time, but I adapted.

It helped to have her family behind her giving the motivation to continue and pass through the diving course; she declared:

> Thinking about my kids and my dad while I was in AIT gave me the motivation to keep pushing through… If something was super hard and I was struggling, I would think, maybe I don't need to do this. I could go do anything else in the Army, and it would probably be easier. But then I would think, could I go home at the end of the day and tell my dad or my kids that I quit? And the answer was always no, absolutely not. That's what pushed me through on my worst days…

A 29-week military diving course is a relentless endurance of challenges to ensure that those who are successful are skilled in underwater demolition and salvage, reconnaissance, and deep sea dives that can be for extended periods of time at a depth of nearly 60m below the surface.

The article stated that while she is currently the only female enlisted Army diver, she gives credit to the female diver who graduated before her with providing her the opportunity. There is no name given for that individual but whoever it was certainly set the ground work for future diver volunteers.

Johnson added:

> She paved the way for me because she was the one who showed the male soldiers that just because we're females, that doesn't mean we have to be treated any differently… We know we joined an all-male field and we kind of go in expecting that it's going to be a little bit different.

Her determination to succeed finds Sergeant Johnson a lead salvage diver for the 569th Engineer Dive Detachment, 53rd Engineer Battalion, 7th Transportation Brigade (Expeditionary). What began as a journey to provide a better life for her children caused her to realize that she has the ability to motivate and encourage young women to pursue their dreams. She stated:

> I hope I can show young girls that they are perfectly capable… You have to put your mind to it, don't quit, try your hardest and keep a positive attitude. I hope I always demonstrate a positive attitude to my fellow soldiers and inspire them to do the same. I really do think that you can get through any of your trials, personal or work-related; it's all about attitude.

Clearly Sergeant Johnson has proved a point, and although today's world of military diving is still male dominated, it can be open to everybody who has the mental and physical aptitude to succeed.

Sgt Stephanie Johnson at work using a surface supplied helmet. (US Department of Defense, photo by Greg Sweney)

Lieutenant Commander Catherine Ker, Royal Navy, United Kingdom

In 2010, as a lieutenant, Catherine Ker was the first woman to train as a Royal Navy Minewarfare and Clearance Diving Officer (MCDO) and to graduate from the Defence Diving School. Ker became the first woman to train after a change in the Naval Service policy that had previously stated female divers ran a greater risk of suffering from decompression sickness than male divers.

The diving course has long-established standards, and all those who partake must meet those standards, and that would have posed an added challenge for Ker, being physically smaller at five feet two inches tall, while wearing the same equipment as the male divers.

The Royal Navy has had female divers in the past, but Lieutenant Ker was the first to graduate from the Diving School since the policy changed, and the Ministry of Defence has not provided an explanation for the change. Lieutenant Ker revealed:

> Finding out that I had passed was one of the highlights of my career so far; it has been my aspiration since I joined the Royal Navy in 2006 to qualify as an MCDO. It has been a hard and demanding course, and to succeed as the first female has been a great achievement. The support of my fellow course members and instructing staff has been great.

Diving Officer Commander Catherine Ker was the first female to train as a Royal Navy Minewarfare and Clearance Diving Officer (MCDO) and to graduate from the Defence Diving School. (PA Images / Alamy Stock Photo)

Now Diving Officer Lieutenant Commander Catherine Ker is an instructor at the Defence Diving School based at Horsea Island in Portsmouth, with the responsibility of providing diver training to the Royal Navy's mine clearance divers, and has remarked on her hopes for more female Royal Navy divers:

> I have changed opinions in the diving world, people now see that it is 'ability' and not 'gender' that gets the job done… I have opened the door for the new generation of female divers… I'm pleased that a few female sailors have passed selection for diver training and we will see them diving in the Fleet over the next few years.

Natasha Senn, Royal Navy Reserve

A scientist at the British government's scientific establishment Porton Down was also a member of the Royal Navy Reserve based at HMS *King Alfred* in Portsmouth. Able Rate Natasha Senn qualified as Clearance Diver in 2012, which at the time made her the only female diver in the RNR, and was the first female reservist to qualify on her Explosive Ordnance course. In 2015 she spent two weeks supporting the Royal Navy's Northern Diving Group in Faslane, Scotland, which involved being a member of a diving team disposing of unexploded ordnance. The role of the RNR is to support the regular Royal Naval personnel. Many RNR personnel have seen overseas service, and in the case of diving that means retaining the diving and ordnance disposal skill-set in a dangerous activity.

Natasha Senn was a member of the Royal Navy Reserve based at HMS *King Alfred* in Portsmouth when she qualified as Clearance Diver in 2012. (roger parkes / Alamy Stock Photo)

Lene, Frømandskorpset, Denmark

The Danish armed forces made the announcement that the first woman graduated from the Danish Combat Diving Course. Identified only as Lene, she is the first woman to have attended and completed the demanding course and is one of just ten sailors to graduate in 2022.

The Frømandskorpset is the maritime special operations force of the Danish Special Operations Command (SOKOM). The qualification course is nine months long, and 500 to 600 applicants start the course, with generally fewer than a dozen selected in the end. The combat diving training aspect lasts two to three weeks and trains the volunteers in the basics of military diving.

Lene receiving her award after passing a frogman diving course run by Frømandskorpset SF. (Danish Defence Department)

For Lene, undertaking the combat diver course has in some part been about developing and refining her skills as a soldier, and partly about paving the way for women in the special forces. She is quoted in the Danish *Naval News* on 18 August 2020 as saying:

> I have been in the Armed Forces for almost 21 years, and I have not seen any woman who has been able to complete the combat swimmer training. I think it was my duty to see if I could contribute on that front, because I had faith that I could do it.

Lene says that she hopes that more women will be inspired to apply for the special forces, because she is a supporter of those who give it a try – even if they are not sure of completing it.

There was a caveat where a Danish reader clarified: 'Lene passed a training course held by the Frogmen, not the course to become a Frogman. She completed a two-week course, not the nine-month course to become an operator.' It added that she is from the army logistics regiment, so not a sailor and the SF select from navy personnel.

However, combat diving is just one challenging part of an extended special forces training programme that includes a wide range of other skills described within this book. A course run by Frømandskorpset is certainly one of the most demanding possible and Lene has set an example of what can be achieved.

Sub Lieutenant Tahlia Britton, Irish Naval Service

Irish naval history was made in August 2020 when Sub Lieutenant Tahlia Britton became the Irish Navy's first female diver. She had to undergo a gruelling 11-week training course which has a 70 per cent drop-out rate, and was one of only three divers to complete the course.

The Naval Service Diving Section (NSDS) is a specialist unit of the Irish Naval Service. The diving unit was first established in the 1960s and is an elite unit of the naval service comprising up to 30 divers. The unit is responsible for search and recovery, underwater engineering and explosive ordnance disposal. Tahlia, who is 29 years of age, was said to be proud of being the Navy's first female diver, and of completing the course.

The diver training course is undertaken at the Haulbowline Naval Base at Cork. Since its establishment, over 1,400 men and women have applied to join the elite unit, with just 150 succeeding – all of them men, until now. Each year, around 50 personnel apply to join the unit; from these about 15 are selected for the 11-week Naval Diving Course, and on average only five complete it. The course is generally conducted during the winter months to prepare divers for the harshest conditions. Each diver needs to undertake 17 separate training courses to stay current on the section's equipment. Their role includes security duties, and they are called on to check rivers and lakes for IEDs as well as by customs to inspect the hulls of suspect vessels below the waterline where drugs or weapons could be smuggled. They also check the hulls of visiting warships to ensure nobody has attached any explosive devices to them.

BELOW
Sub Lieutenant Tahlia Britton about to have the helmet fitted before undertaking a surface supplied air dive. (Óglaigh na hÉireann)

BELOW RIGHT
Sub Lieutenant Tahlia Britton undertakes a long-distance surface swim without diving equipment. (Óglaigh na hÉireann)

First Lieutenant Christie Plackis, US Army

First Lieutenant Christie Plackis told Army.mil on 25 March 2013 that she initially had no idea what Army life was all about, but from an early age she began swimming competitively, which prepared her for her ambition to become a diver. Throughout her education she maintained her connection with water activities and became involved in coaching and lifeguarding. This helped keep her in good physical condition for life in the Army and her desire to become a diver.

First Lieutenant Christie Plackis, the fourth female diver in the history of the Army, who serves as the executive officer for the 74th Engineer Dive Detachment, deployed from Joint Base Langley-Eustis, VA, is briefed for a dive. (Photo by US Army Sgt Micah VanDyke, Third Army/ARCENT Public Affairs)

In 2007 she was informed that Army officers could become divers, and that became the catalyst for her future. She said: 'This is what I'm going to do… I don't care that the numbers are against me or that I'm the only female.'

At the Basic Officer Leader Course at Fort Leonard Wood she questioned anyone who mentioned divers to elaborate and found many times that the responses weren't pleasant.

> I was so excited to be a diver that I asked an instructor questions about the dive field… When I told him I wanted to become a diver, he responded by saying, 'nope, you're too small and weak.'
>
> There were a lot of haters. I had to step back and remind myself that they don't even know me… It just fuelled the fire to train harder. It made the fire even bigger. It made me angry but determined, it motivated me.

First Lieutenant Christie Plackis, being prepared for the dive, signals with the 'OK' hand gesture. (Photo by US Army Sgt Micah VanDyke, Third Army/ ARCENT Public Affairs)

She had to attend a Dive Officer Selection Board, which consisted of leadership from the Army engineer diving field, who interviewed her after she endured an extreme water physical fitness assessment lasting several hours. That was her entry point to dive school.

Phase one was three physically intensive weeks of training, which she passed and moved on to phase two of the training, spending six months enduring the Army diving training at the Naval Diving and Salvage Training Center, Panama City, Florida.

She was honest in her own evaluation when she stated: 'I liked PT, but it was always one of those morale killers for me, everyone else finished before me during CrossFit… [the] strenuous physical fitness routines consisting of 100 pull-ups, 500 push-ups and other extreme exercises.'

Army and Navy divers train together during dive school, and a Navy diver on the course, who held traditional views regarding who should and should not be on a diving course, spoke to her:

> I have a lot of respect for you… You worked so hard on your push-ups and pull-ups after duty hours. During the toughest times, watching you made us say, 'How can we quit? If she can do it, we can do it too.'

Her response was interesting:

> I was so encouraged. I realised in dive school that my presence, my existence, makes people better… Just the fact that I am there and not

quitting, meant they weren't going to quit. I went there to meet the standard, I didn't go there to do less.

Seaman Nancy 'Kati' Garner, US Navy

Nancy 'Kati' Garner came to recognition as the first woman to go through and graduate from the United States Navy Diving School in 1973, and was featured in Hillary Houser's book *Women in Sports – SCUBA Diving*, where Houser described Garner's experience:

> In this traditional male-only world, even some of the strongest men can't make it. That's how tough it is. But Kati did, and her feat cannot be attributed to muscles or physique, because this blue-eyed girl is only 5'3" tall and weighs 115 pounds. 'Punk', as they called her, ran five miles, did 500 flutter kicks, and swam a minimum of one mile anytime she was directed to, along with the toughest and roughest of her fellow students… The first Tuesday of the diving school training is known traditionally in the school as 'Black Tuesday', and for good reason: 'They give you a pretty rough hour of calisthenics. They got us out there and made us run after every exercise, they wore us out, and then they had us play leapfrog with about 23 guys. They were standing around with their legs straight, their rear ends sticking up, and boy, were they hard to get over!' … Another ordeal of Black Tuesday was the qualifying swim. For that test, the students had to swim the length of an Olympic size pool underwater, taking only three breaths. On top of this, they had to swim about a quarter mile. Five men dropped out at this point… The final week of the scuba school consisted of actual diving projects in San Diego Bay. The culmination was a 120-foot dive into the cold. Kati suffered an ear squeeze, no doubt due to congestion brought about by her illness, but she didn't attach much importance to it. She had won her diploma.

Garner subsequently taught survival-at-sea tactics to pilots and aircrew. She later worked at the Marine Mammal Program.

Seaman Diver Nancy (Kati) Garner zips up her wet suit as she prepares for a dive in March 1974. She was the first female Navy diver and was assigned to the Fleet Aviation Specialized Operational Training Group, Pacific. (US Department of Defense, NARA)

First female soldier to pass the US Army Combat Diver Qualification Course

The first female soldier to pass the US Army Combat Diver Qualification Course is an Army Cadet in the Reserve Officer Training Corps (ROTC), from the University of Alabama, who has asked not to be named. The course is generally open to Special Forces soldiers (commonly referred to as 'Green Berets'), Army Rangers and a few US Air Force Special Warfare. However, the US ROTC has a very limited allocation for suitable candidates to attend the extremely tough course each summer.

The cadet became the first woman soldier to graduate from the Army Special Forces Underwater Operations School (SFUWO). SFUWO is located in Key West, Florida, and its primary mission is to train Army Special Forces operators, such as Green Berets, Army Rangers, and even Delta Force, to become combat divers, dive supervisors or dive medical technicians. In addition to passing the course she was chosen as the class honour graduate, which is reserved for the best student who has distinguished themself throughout the course. She stated that:

> My class began with 45 people total; 11 Cadets, one Ranger, 33 Green Berets. We graduated with 26 total; seven Cadets, one Ranger, and 18 Green Berets. Every attendee is treated the same and there are no exceptions as standards are set and must be met.

An Army Cadet from the University of Alabama is the first female soldier to pass the US Army Combat Diver Qualification Course at the US Army Special Forces Underwater Operations School (SFUWO). She also received the best course participant award. There is no distinction between men and women – it's equal hell for all. (Author's Collection)

It was confirmed that there had previously been two other females who undertook the CDQC, one an Air Force Combat Controller who graduated the course in 2020, as part of Air Force special warfare training. The other was a West Point cadet who was not successful.

It is a six-week intensive course, where the CDQC graduates approximately 300 students every year. It teaches surface and sub-surface waterborne infiltration, including the use of the Draeger closed-circuit oxygen rebreather. The other courses are supervisory, and medical. To apply, the cadet must have already

excelled at their home unit and passed several in-house assessment and training courses before getting admitted onto the course. The cadet stated that: ‘It was very tough but the instructors were very professional and went into explaining every detail on every aspect of the course and equipment.’

Lino Miani, President of the Combat Diver Federation, says that if in the future the cadet aspires to attend Special Forces selection, she has already shown that she has what it takes.

The first female US Army SF ‘Green Beret’

Earning the right to wear the green beret is an incredible feat for any soldier, but becoming the first female soldier to earn one is not only historic, it’s an important message to soldiers of all types across the force: being a man is not a prerequisite to becoming one of America’s most elite war fighters. What we know about this history-making soldier is that she was among only a handful of women that made it through the initial 24-day assessment that serves as a screening to eliminate those who may not have the mental or physical capacity to complete the training. Once graduated, training continues with specialist courses, and she may well consider enduring seven weeks on the Combat Diver Qualification Course, at the Special Forces Underwater Operations School in Key West, Florida.

A first in Naval Special Warfare

A woman has also successfully completed a Naval Special Warfare (NSW) selection and training programme, earning her designation as a member of the NSW community. The sailor, who remains unidentified, completed Special Warfare Combatant-craft Crewman (SWCC) training, and is NSW’s first female Special Warfare Boat Operator. The 37-week training programme, while similar in some respects to Basic Underwater Demolition/SEAL (BUD/S) training, is nonetheless a distinct and separate training route dedicated to producing the sailors who will crew the NSW’s combatant-craft.

The sailor was the first of 18 women to date to have tried out for either BUD/S or SWCC and to have successfully completed the selection and training (three of those are still in progress: one in SWCC, and two in BUD/S). The sailor graduated with 16 other SWCC trainees and was awarded her Boat Operator warfare pin on 15 July 2021.

There are currently around 800 sailors who make up the ranks of the SWCC and who belong to one of three Special Boat Teams (SBTs) within NSW’s Group Four command. Each of the SBTs is commanded by a SEAL officer, and certain other subordinate boat detachments within the SBTs might also be commanded by a SEAL officer.

Arlene Salimbacod, a combat diver with the Philippine Navy Special Operations Group, taking part in a joint US and Philippine Navy exercise. (US Marine Corps photo by Sgt Trystan Jordan)

Philippines female combat divers

When people hear of the NAVSOCOM, they immediately associate the unit with men with exceptional military skills; however, this elite force also has within its ranks female divers who have undergone the Military Scuba Diving Course conducted previously by the Naval Special Operations Training and Doctrines Command, and recently the Naval Diving Group of NAVSOCOM.

However, women make up less than one per cent of the Philippines' military divers, even though the position has been open to women under the same physical standards as men for years. Only a few dozen women have ever qualified as military divers since it was opened in 2002, and only one female technical diver in the Navy. They are usually involved in underwater maintenance, underwater inspection, underwater search and retrieval operations, as well as other operations which have not been publicized. Despite the risks associated with diving, it has not hindered the female navy divers in performing and succeeding in their tasks. Today, women can do the same work as men do; they only need the opportunity, and the NAVSOCOM are providing that.

LEFT
A dive team preparing to undertake a search and recovery operation alongside a harbour wall with a female team member. (Philippine Navy Special Operations Group)

BELOW
A navy male–female dive team working on the underwater inspection and maintenance of a warship. (Philippine Navy Special Operations Group)

CHAPTER EIGHT

SPECIAL FORCES DIVER SELECTION AND TRAINING

The selection and training of a combat diver in most countries invariably follows a similar basic format. It starts with volunteers as not everybody is suited to the role, be it special forces, clearance diver, explosive ordnance disposal or engineer. In most instances diving is a means to an end and is just one tool in the box of skills that will enable the diver to carry out a limpet mine attack, conduct a beach reconnaissance or infiltration, and clear a mine or bomb, among a list of tasks. This chapter reviews a number of countries and some of their units to provide an overview of selection and training.

Every diver will undergo a basic air diving course which uses equipment similar to that used by recreational divers, and for some military divers it will also be the equipment they use in their military diving role. Special forces, navy clearance divers and those with a similar role will train in and use closed-circuit mixed-gas breathing apparatus, with a particular emphasis on the effects of the equipment in the mine-clearing role.

An important part of any diver's training is to understand about depth and time and the importance of a decompression chamber. The divers are in the inner chamber undertaking a decompression procedure. The operator is checking the outer chamber, which is not at depth. Should there be a medical emergency, a qualified medical person could enter the outer chamber, then, with the outer door closed and the two chambers equalized, gain access to the patient. (US Navy photo by Petty Officer 2nd Class Shannon Burns)

A sound and thorough selection and training programme for combat divers is vital, as is keeping up to date. As with any skill, divers need to keep operational as well as maintaining their fitness level. In the case of special forces divers, the selection and training is in addition to the initial special forces selection.

The UK

Special Boat Service

Everybody seeking to join the UKSF (SBS or SAS) must pass the joint selection process and then move on to further selection and training with their chosen unit. The failure rate is high at around 90 per cent, and those not meeting the standard or by voluntary termination will return to their unit of origin. There is a two-day Special Forces Briefing Course for all those who have applied to do the selection and those who pass this first phase can move on to the next phase, which lasts four weeks, beginning with a Battle Fitness Test, which identifies anyone without a basic level of fitness. The first three weeks of selection take place on the hills of the Brecon Beacons in Wales, where a series of timed marches are undertaken wearing heavy bergens, and candidates must navigate alone over the steep hills to manned RV points where a map reference to the next point is given. The objective is to test stamina and the ability to keep going with blistered feet, cramps, and whatever the weather throws at them. Over the three weeks, the marches get progressively longer, and the bergens get heavier until the climax known as 'the long drag' – a 40km march that must be completed in less than 20 hours. Those who are still standing at this stage – and there won't be many – will enter Initial Continuation Training, which lasts four weeks. At any point in the process a volunteer can opt out or the training team can remove anybody from the course they feel is not up to standard. Those who remain at this point are sent to the rainforests of Belize to undertake jungle training, and again they are pushed to their limits of endurance. The particular skills needed to meet the demands of navigating, patrolling, fighting and surviving in dense jungle are taught and practised, followed by a number of exercises to test the volunteers on what they have learned.

Those still remaining undertake combat survival, which features a series of lectures on escape and evasion techniques and is followed by an escape and evasion exercise in which the volunteers are given tasks to perform while being hunted down and captured by other troops (often Royal Marines or Paras). Once captured, they are subjected to intense interrogation. This means that while waiting for questioning the volunteers are placed in stress positions, deprived of food, water and sleep, and subjected to white noise. They are then interrogated and should only give very limited information to avoid serious harm or death. The statement 'I cannot answer that question' has only so much value and will reflect on the interrogator. The option still remains to opt out, or for the training team to terminate the volunteer.

The few that make it through to this point are, for SAS volunteers, given their beige berets and assigned to a squadron in the Regiment, and for those destined for the SBS, granted their green berets and moved onto further selection processes which test their ability in the water. The first task is to become a swimmer canoeist third class (SC3), and that involves training to be able to dive in all conditions, canoeing (generally over long distances), underwater demolitions, limpet mine attack, and beach reconnaissance and surveying techniques. Anybody that has reached this stage of selection is technically in the SBS, but is still under probation and subject to being returned to their original unit.

Royal Navy clearance divers

For many years the Royal Naval diving training was based at HMS Vernon in Portsmouth, with in-water training carried out at Horsea Lake. In a rationalization process all military diving moved to the Defence Diving School on Horsea Island in September 1995 and this is where the Navy and Army combine to undertake diver training. The facilities on the site predominantly focus on diving, underwater engineering workshops, decompression chambers and diving equipment testing capabilities, and of course the long rectangular expanse of water where underwater distance dives are carried out.

For the Royal Navy diver it all begins with ten weeks of basic training at a Royal Navy establishment where the formal basics of navy life are taught. For those planning to become clearance divers there is a need to reach and maintain a high level of fitness, as diving is a physically demanding job. At the end of basic training those who meet the requirements for becoming a diver commence the 20 weeks of specialist diving training, which will include learning the theory behind all the equipment the Navy uses, and undertaking dives in Portsmouth Harbour and Horsea Lake, where many hours will be spent underwater learning and honing open-water diving skills. The course participants will learn and practise beach reconnaissance, mine clearance diving and basic mine warfare using the latest equipment. Those who pass are assigned to a ship or shore establishment diving team.

The Netherlands

Marine Special Forces

The Dutch Maritime Special Forces training takes approximately 40 weeks, and eligible Marines are trained to become Special Forces operators and maritime counterterrorism specialists, with emphasis on maritime special operations. Those who wish to specialize for Mountain Leader or as a frogman can apply for these specializations following completion of the initial Special Forces training. NLMARSOF (Netherlands Marines Special Operations Forces, generally shortened to simply MARSOF) is modelled after the British SBS.

A Danish frogman undertaking an endurance swim in the Frømandskorpset selection process, which is an example of the similarity of the different SOF frogman selection and training. (Danish Armed Forces, Henrik Palshøj)

All candidates must initially pass the International Certificate of Competence (ICC) for inland and coastal waters, and SF boating drills in general are part of the MARSOF operator course.

Only once candidates are already SF badged (i.e. having passed the initial MARSOF qualification) can they apply to attend the Frogman Course. The Dutch Frogman Course is built up in four phases: pre-selection; basic military air diver training; Military Oxygen Diver training; and Combat Diver Course. The phase one pre-selection tests constitute a psychological test consisting of standardized personality questionnaires and an interview with a psychologist (half a day); dive medical examination (half a day); and a swim test (half a day).

Phase two is basic military air diver training, a seven-week course which is broken into three parts: basic military air diver training in conditioned environmental circumstances, i.e. swimming pool and 9m dive tower (three weeks); open-water military air diver training (two weeks); and decompression military air diver training (two weeks).

During phase three, Military Oxygen Diver training, the participants spend four weeks learning how to dive with the closed-circuit system (LAR, made by Draeger), and also how to dive with the rebreather in the semi-closed mode by using nitrox, before moving on to phase four.

Phase four is the Combat Diver Course. During this final phase all combat diver Standard Operating Procedures (SOP) and Tactics, Training and Procedures (TTPs) will be taught under realistic operational circumstances for 12 weeks. Training also covers submarine Exit & Re-Entry in a simulated pressurized escape tower.

There are two aptitude tests at the end of the instruction course. Test 1 – Individual level: cover 100 kilometres by canoe within 24 hours; a 10km surface swim with complete operational gear within five hours; and a continuous three-hour dive with rebreather system covering 3 kilometres. During the second aptitude test (Individual level within an SF team) the participants will work as part of a team in simulated realistic scenarios under real life operational circumstances. The missions will be planned and prepared by the candidates themselves using SF planning procedures. Up to and including aptitude test 1 will be undertaken in the Netherlands, while aptitude test 2 (last three weeks of the Frogman Course) will be elsewhere although preparations for that are made in the Netherlands. Similarly, Combat Enhancement Training (CET) and Force Integration Training (FIT) and execution will be undertaken in a foreign country.

If an individual is deemed unsuitable at any point, they are returned to their NLMARSOF squadron. This could be because of dive-medical reasons, motivational or psychological reasons (rare), or concerns regarding compliance to skills/competencies of the frogman which are defined by NLMARSOF (also rare). Candidates who leave the course due to recoverable dive-medical reasons are eligible for a second try. Approximately 60 per cent pass the Frogman Course.

Each frogman is also a certified military free-fall parachutist (MFF). Additionally frogmen are trained in individual specializations needed to operate either independently or in a team in or behind enemy territory. Examples are: communication specialist (COMSPEC); demolition specialist (DEMSPEC); sniper; and SF medic, to name a few.

As soon as a frogman completes the course they are deployable in any operational situation anywhere in the world, and are classed as ready for duty. Insertion areas include: direct action; counterterrorism; sabotage; ship attack; boarding operations; recovery operations; semi-closed-circuit diving and

combat diving, with or without means of diver-assisted propulsion systems. All SF frogmen remain part of the NLMARSOF. As such they operate within NLMARSOF, or they can be seconded to any other units of the Royal Dutch Marines where needed. During this period the divers will keep on acquiring experience in their field of expertise, and further training will be the responsibility of their designated unit.

Since 2015 the Belgian Special Forces Group (SFG) participate in the Dutch Frogman Course. The course is slightly modified for SFG candidates. To participate the SFG candidates have to pass the Belgium basic air and rebreather training first in their own country. After passing the Belgium dive training the SFG candidates will join the Dutch during the technical oxygen phase of the Frogman Course.

The United States

Sea, Air and Land Forces: Navy SEALs

Selection for entry to a SEAL team is voluntary, and the same basic course is taken by all officers as well as enlisted men. The training is open to all members of the US armed forces, as well as candidates from friendly countries. Those found to be medically and mentally suitable join one of two centres, to begin an arduous course that will eliminate those who do not make the grade. The SEAL units combine to number some 2,000 officers and enlisted men, and not all will be SF-qualified divers.

Volunteers for combat diver training have hands tied behind their backs and ankles tied before entering the water to keep moving and become accustomed to being in water, and to develop confidence. (US Department of Defense, photo by Senior Airman Ryan Conroy, 1st Special Operations Wing Public Affairs)

ABOVE
Tadpoles (combat diver trainees), as they are known, are introduced to the basic SCUBA diver training (military style). (Photo by Richard Schoenberg/Corbis via Getty Images)

ABOVE RIGHT
The trainee divers quickly master the basic skills in a pool-controlled environment, including taking care of the personal weapon, guided by proficient instructors. (US Marine Corps photo by Cpl Brendan Mullin)

RIGHT
The drills taught and practised teach confidence in using the equipment while underwater. Removing and replacing a mouthpiece as well as sharing with another diver becomes a normal action. (Photo by Richard Schoenberg/Corbis via Getty Images)

FAR RIGHT
US Navy SEALs use SCUBA diving equipment to gain diving experience before they move on the closed and semi-closed equipment. (US Marine Corps photo by Sgt Isaac Ibarra)

Those selected attend the first four weeks, which are without doubt tough, and start with two weeks of pre-conditioning training of calisthenics, which begin easily and work up to an arduous pitch by the end of the second week. A volunteer can quit at any time by ringing the bell and then returning to their original unit. Those who have not opted out or been terminated by the training team will begin the third week, where the volunteers are divided into seven-man boat crews. The boat crews are designed to generate a competitive team spirit where every individual has to perform and not let the side down. Those who do not perform are removed from the course and those remaining move to the third and fourth weeks, which are heavily committed to physical training as well as induction into the role of the SEALs. This is where volunteers are taught to recognize different types of beaches from the silhouettes of terrain at night or in low visibility. They learn how to produce tactical sketches of beaches, determine conditions of surf and currents, and how to interpret reconnaissance photographs, and specialist training is given in the use of communications equipment. The course will identify those who can learn quickly, retain the

information and above all understand what is required, so being super fit is simply not sufficient to get through. Week five is motivation week, and is where the previous four weeks' training is put to the test, in both mental and physical attitudes. Working in small units, the men undertake exercises in simulated combat conditions.

'Hell week' is where reconnaissance missions, sabotage raids, establishment of camps and their defence, are combined with competitive races of endurance, team against team, all of which are done in sand, surf and mud. Sleep is brought down to a minimum, and the training teams carefully observe each individual, seeking out those who weaken. Even at this stage of the course, many will fall by the wayside, and return to their previous unit. Those remaining will have passed through the harshest part of the training programme, and will begin the serious business of learning the art of becoming a full member of the SEALs, although termination is still possible.

The men are introduced to the different types of underwater diving suits and breathing equipment. Compressed-air scuba diving is followed by the use of closed-circuit systems. Underwater navigation and endurance swims are combined with beach survey and advanced demolitions, both topside and underwater – all are taught in detail, and those not parachute-qualified depart to one of the basic parachute training schools to gain their airborne wings.

ABOVE LEFT
There is strong emphasis on connecting with water and on teamwork. The team comprises those in each boat and each team's boat has to be the best. (US Navy, photo by Kyle Gahlau)

ABOVE
For the SEALs coming ashore, is not the end, as they carry the boat back to its compound then continue to the next task. (Photo by Richard Schoenberg/Corbis via Getty Images)

LEFT
US Navy SEALs are conditioned to being in the surf, being battered by the sea, irritated by the sand and enduring the cold, day or night. Anybody can leave at any time to ring the bell and leave the course. (Photo by Richard Schoenberg/Corbis via Getty Images)

Those who complete the entire course are accepted into the unit and join one of the SEAL teams to become a member of the US Navy's Special Warfare Group. They wear the same uniform as all US Naval personnel, although identified by special insignia.

Continuation into a SEAL team begins with a thorough grounding in HALO and HAHO parachuting methods, followed by courses at the Army's Special Warfare School, where the syllabus covers survival, weapons handling (both US and foreign makes), combat medicine, fieldcraft and camouflage, communication and specialized explosive training. Further advanced training is undertaken at the jungle and arctic warfare training centres, all of which combine to produce a highly trained and motivated combat diver, at home in the water and on land.

Marine Corps Force Reconnaissance

Those seeking to join Force Recon, as it is commonly referred to, will have already undertaken the thorough and demanding Marine Corps training and are operationally experienced. The training of a Marine for Force Recon lasts about a year, where they learn the skills of amphibious infiltration and reconnaissance behind enemy lines. As part of the water operations all of the team members qualify as divers at a Naval Diving School, and undertake a parachute course which will enable them to make 'wet' drops. They train in the types of boats available, as well as the skill of packing and waterproofing equipment. Diving, distance surface swimming, navigation, and the use of specialized reconnaissance equipment becomes second nature, as does being proficient in leaving and entering submerged submarines.

A US Army Green Beret Special Forces combat diver deploys from a helicopter into the sea. (Stocktrek Images/ Getty Images)

US Army Special Forces ('Green Beret')

Those seeking to join the Special Forces and attain the coveted green beret will first and foremost be a serving member of the US Army, with three years' experience in another unit. After volunteering for selection, each candidate is screened for fitness and motivation. Those successful at that stage enter the Special Forces School at Fort Bragg, North Carolina, to begin a demanding 16-week programme. It consists of three separate phases and in the first phase a volunteer operates as an individual, where individual performance is closely monitored and it is during this phase that the highest number of terminations are expected, either by the individual or staff decision. The second phase focuses on specialization, where the individual undertakes intense training in a number of specialist subjects such as combat diving, which would be used for infiltration purposes. The final phase is where the individual becomes a team member, and all of the skills they have been taught are tested. Any individual can leave of their own accord at any time or be terminated by the training team, with the percentage of terminations for either reason being in the order of 70 per cent.

ABOVE LEFT
Combat divers' training involves undertaking long-distance surface endurance swims at sea, some with equipment bags, others with a rescue tow of a fellow diver. (US Marine Corps photo by Cpl Chelsea)

ABOVE
SF candidates complete an endurance swim, testing the volunteers' determination to keep going. (US Navy photo by Petty Officer 2nd Tim Miller)

LEFT
The SF distance swims are arduous and that can be added to when carrying out a rescue exercise where one diver tows their buddy. (Photo by Richard Schoenberg/Corbis via Getty Images)

ABOVE
Green Berets are trained to infiltrate underwater or on the surface to reach their target area, then move from water to land ready for their mission. (US Army photo by K. Kassens)

RIGHT
Combat divers, dressed and ready to take to the water. The middle diver is carrying a swim board that is equipped with a compass, depth gauge and other attachments depending on the requirements of the mission. They are using the Draeger closed-circuit oxygen rebreathers. (US Marine Corps photo by Cpl Matthew Manning/Released)

The first test for the volunteers is in the form of a week's exercise in a national forest. The first half is held in the gentler southern part of the forest and is a preliminary work-up, with a culmination of three days held in the rugged northern area. Here the volunteer is dropped by parachute or helicopter, and armed only with the clothes they are wearing, plus a knife, are told to evade their pursuers. The volunteer must move unseen, live off the land, and above all must not be caught, while those searching will go all out to capture a prospective SF operative.

Those who pass this phase and who are not parachute-qualified attend one of the Airborne Schools where they undertake the US Army's basic parachute training course. Every Green Beret is a specialist and is highly trained in one of four prime subjects: weapons; engineering; communications; or medical. The grounding in the subject allocated is the most thorough available, and each volunteer remains under scrutiny, and can be terminated if they do not meet the standards.

Those passing this phase move on to the final part of the programme, when the volunteers are formed into 'A' Teams and parachuted into the swamps of a national forest, where they are hunted by a determined aggressor force who have the sole ambition to capture and discredit the SF volunteers. Once in the operational area, the teams gather groups of locals, made up of soldiers of a non-combatant variety, and begin the task of forming them into a guerrilla force, which they then lead into an unconventional war against the aggressors. This phase lasts for a month and at the end of the exercise those who are accepted move on to further and more intensive training, and attend a combat diving course where they train for covert infiltration wearing the green beret of the Special Forces.

The Green Beret will also have endured seven weeks on the Combat Diver Qualification Course, or CDQC, at the Special Forces Underwater Operations School in Key West, Florida. The course is seven weeks long and includes a 'Zero Week' where they are put through a series of training and testing events that are carried out in the controlled environment of a swimming pool.

Zero Week involves tests including swimming underwater for 45.7m on just a single breath, and they cannot touch the bottom of the pool or break the surface of the water. Then there is a test called 'drown-proofing' that requires their hands and feet to be bound before entering 3m of water to bob up and down for five minutes, and if they break the straps or touch the sides of the pool, they fail. When they bob up to the surface and take in a breath of air, it must be a controlled breath with no sign of panic. The swimmers are then required to float on the surface for two minutes, followed by a 91m swim around the pool, all of which follow in succession while their hands and feet remain bound. Once the swim is complete, students must perform a front roll and back roll while underwater in the deep end of the pool, without touching the bottom or sides. As soon as candidates have completed the rolls they have to grab a face mask, which is located on the floor of the pool, with their teeth. Once the face mask has been collected they have to do five more bobs while holding the mask in their mouth. Dropping the mask, breaking their restraints, touching the sides of the pool, or not completing the bobs appropriately is classed as a failure.

Once the pre-qualification tests are done, those remaining move on to working with open-circuit diving equipment and undertake open-water swims in the bay. Week one is designed to identify those who are not destined to become combat divers, and a number of those on the course will either depart the course of their own accord or be returned to unit (RTU'd).

Weeks two and three are devoted to closed-circuit diving equipment training, including navigational diving, buddy breathing, and tactical swims in full gear and equipment. Week four is boat and watercraft training, which includes the use of diver propulsion devices (DPDs).

In weeks four, five and six, they move on from two-man dive teams to operating as an entire element of ten to 12 divers, giving them the opportunity

to work as a detachment, which is what they can expect to do in their operational groups. Week five involves insertion training and brings together all the previous training throughout the course. They undertake drops from helicopters and navigate their way by inflatable boats to their objectives.

Week six requires the divers to use everything they have learned by undertaking a 48-hour field training exercise. The infiltration includes a mission for an entire team while the instructors serve as the opposing force. Upon successful completion of this exercise they undertake a 14.5km run the following morning, and the final three days of the course are dedicated to cleaning and maintenance. Those remaining have passed the combat diver element of their SF training course.

Australia

Navy clearance divers

All personnel and all ranks, including officers, joining this branch of the Australian Navy have to undergo acceptance tests and complete the arduous requirements of the CDQC. The Basic Clearance Diver Course covers 37 weeks while the Advanced Clearance Diver Course and the clearance diving component of the Mine Warfare and Clearance Diving Officers' Course covers 41 weeks. These lengthy demands are not seen with any other Australian Defence Force unit outside of the special forces. The clearance diver selection process and training has allowed clearance divers to serve in the counterterrorist squadrons of the SAS Regiment and continue to serve in that role with the 2nd Commando Regiment and 4 Royal Australian Regiment (TAG East).

Having carried out an underwater swim, a clearance diver breaches the surface, weapon in the ready to use position, and moves ahead to the beach. (Australian Department of Defence)

The Australian Defence Force Diving School is located at HMAS Penguin, Sydney, NSW, where training in diving, demolitions and explosive ordnance disposal takes place. The school is responsible for training the RAN's Clearance Diving Branch for both enlisted sailors and officers through various courses, which include the Basic Clearance Diver, Scuba Air, Scuba Supervisor, Dive Yeoman and the Clearance Diver Selection Test. As well as training the RAN, the school provides tri-service Explosive Ordnance Demolition training, and the Australian Army Work Diver course.

Army commandos

Any member of the Australian Defence Force may apply for entry into the 2nd Commando Regiment and all candidates must complete the Special Forces Screen Test, and if successful they will move onto the six-week Commando Selection and Training Course (CSTC). Commando selection and training is carried out at the Special Forces Training Centre (SFTC), in Singleton, New South Wales. Further training is undertaken during Commando Initial Employment Training, also known as the 'Reinforcement Cycle'. The commando courses include basic parachutist, combat diving, small-scale raids, demolitions, climbing and roping and unarmed combat. Diver training is undertaken at the Australian Defence Force Diving School, and the 2nd Commando work alongside clearance divers on operations. Upon successful completion of all courses the soldiers are posted into one of the Commando Companies where further specialist training occurs. Counterterrorist training is conducted at the Special Forces Training Facility (SFTF) based at Holsworthy Barracks, with an indoor range complex, aircraft mock-up, method of entry facility, urban training facility and sniper range.

France

Naval Commandos

France's Naval Commandos are a unit of special forces that operate under the Naval Rifle and Special Forces Command as well as the Special Operations Command. They have bases across the country, but mainly in Northern France. Those who seek to enter the Naval Commandos must already be a Fusiliers Marins with at least nine months' service, as they will be participating in one of the toughest courses in the French military. The first element of Commando selection begins with one week of physical and mental testing, followed by six weeks of preparatory training and four weeks of evaluation. The commando skills section lasts for seven weeks, followed by two weeks' paratrooper training. Any mistake made by the volunteers during this process might mean instant disqualification, as every effort is made to uncover the strengths and weaknesses of each volunteer. Some of the tasks they endure include long marches carrying heavy loads, marksmanship, hand-to-hand

The French Commando Hubert combat divers are trained to operate in all water conditions and be adaptable in both warm and cold waters. The lack of underwater visibility is often a challenge for combat divers and is a skill to be mastered. (Photo by Alexis Rosenfeld/ Getty Images)

combat, counterterrorism, explosives, navigation and waterborne activities. All of these take place with little rest in between, and only two hours' sleep per night are permitted. Recruits are awakened to the sound of grenade simulators, and little comfort is permitted by the instructors, who reward mistakes with gruelling physical exercises. For those who complete the training, the ultimate reward is being awarded and wearing the *bérets verts* and joining a small group of approximately 500 men. Those who will be combat divers are assigned to Commando Hubert.

Prospective Commando Hubert members are selected from personnel currently serving in French Marine Commando units and undertake training at the French Navy's dive school located at Saint-Mandrier, near Toulon. The school runs 17 separate courses for their armed forces personnel. The first phase of combat diver training consists of attaining the basic diver qualification, and the second phase is an advanced diving course, restricted to combat divers and ordnance clearance (EOD) divers.

The combat diver course is open to service personnel who hold the basic diver and commando qualification and those seeking to undertake the course must have served for four years in the Navy, have at least six months in a marine commando unit, and have a recommendation from their commander.

Each November a list of 24 candidates is submitted to a selection board. After reviewing the candidates' service records, nine to 12 candidates are selected to attend the course. The course last 27 weeks and is broken down into three phases. The first phase lasts 11 weeks, of which the first four weeks are

devoted to learning basic diving skills and oxygen diving. During the fifth week students learn basic demolition skills. Over the next three weeks students are instructed in the use of closed-circuit rebreathers, underwater navigation, waterborne insertions and the basics of small boat handling. The last three weeks of phase one consist of underwater navigation exercises.

Phase two also lasts 11 weeks, and is subdivided into four phases. The first part of phase two lasts six weeks and includes instruction on conducting sabotage attacks on shipping, small boat handling, the use of the Klepper two-man kayak and water navigation. The last two weeks of this phase consist of training exercises to test what has been taught. During the exercises the volunteer must successfully penetrate the harbour defences at Toulon, place a simulated charge on a ship and escape without being detected. To increase the difficulty of the task, the ship's crew and harbour security forces are forewarned of the impending attack. The second exercise consists of a simulated raid on the Isle of Porquerolles. The raid exercise lasts for one week. To complete this phase the students must pass one final exercise that combines all of the skills they have been taught so far, conducted in the Atlantic Ocean along the Brest coastline.

The final phase of instruction lasts five weeks and is focused on underwater demolition, obstacle clearance, parachute operations (primarily water jumps with and without equipment) and underwater engineering. Upon completion of this phase the new divers are awarded the Combat Diver Qualification Badge, which consists of two sea horses imposed over an anchor and wings.

The 2nd French Foreign Legion Parachute Regiment

The 2nd French Foreign Legion Parachute Regiment (2nd REP) is located at Camp Raffalli, Calvi, Corsica. The French Foreign Legion provides online detailed information for those seeking to join, though famously, potential recruits must go to mainland France and knock on the door of one of the Legion's recruiting offices where there is an interview and, if accepted, passports are eventually handed over to those who meet the basic requirements and they sign a contract for five years.

The entire recruiting and selection process takes two to five weeks, but will depend on each individual, and selection is only made to those who are good enough to meet the Legion's high standards. Only ten to 15 per cent of applicants are accepted. The candidates are selected by the commission, consisting of around 15 members of the Legion's HQ, who verify individually all aspects and results of every single candidate. The majority of these senior members have to find consensus and vote for the candidates to be accepted into the Legion. During the selection process and during the four-month basic training, the recruit is repeatedly asked to choose the preferred regiment they would like to serve with. If they have a particular skill, such as combat diving, with another country's military, then that might get them assigned to a similar role.

The 2nd REP contains the 3rd Company, which specializes in amphibious warfare. The company undertakes amphibious training courses, divided into three levels:

- Level 1 (bronze) lasts 15 days. Legionnaires are taught to steer and control an inflatable boat, and learn the basic tactical procedures required for amphibious operations.
- Level 2 (silver). Legionnaires learn to steer and control an inflatable boat with a larger outboard engine, swim 8km with fins in less than four hours, and more advanced procedures specific to amphibious operations.
- Level 3 (gold) is a consolidation of the two previous courses and includes use of and navigation in a canoe. At the end the legionnaire who passes will be able to participate in all 'missions' carried out by the amphibious centre.

The French Foreign Legion is part of the French Army, and to be an Army diver they must be a volunteer, medically fit, suitable for diving and certified as a parachutist. After having passed the selection tests a diver will undertake the elementary five-week diver course, followed by two weeks of underwater work at the Navy diving school in Saint-Mandrier, France.

The centre also provides an offensive intervention qualification course, covering closed-circuit oxygen diving with three weeks of pure technique and mastery of the device and two weeks focused on tactics. Qualified divers develop their know-how in covert reconnaissance and exfiltration. The training is primarily intended for special forces divers and, in addition to diving using air and gas mixtures, it includes hyperbaric chamber handling.

Singapore

Military dive units

The Republic of Singapore Navy has created as part of its maritime special forces a combat diver organization that comprises three elements: a Special Warfare Group for commando and diver warfare; a Clearance Diving Group for underwater ordnance disposal; and an Underwater Demolition Group for salvage operations

The Special Forces Qualification Course (SFQC), which lasts nine months, is where divers are transformed into special forces operators by going through training in specialized combat diving, military free-fall parachuting and advanced demolitions.

Special Warfare Advanced Training (SWAT), which lasts four months, is where divers are trained in highly specialized advanced diving techniques to operate effectively in the Special Warfare Group.

During the CDQC the diver learns to undertake underwater recovery operations of personnel and sensitive equipment, which will qualify them to perform ships' hull clearance operations and the disposal of naval mines. Like other nations, the courses are tough and the attrition rate high.

Germany

Kommando Spezialkräfte Marine combat divers

Anyone who wants to join the Kommando Spezialkräfte Marine (KSM) combat divers unit can contact the unit directly or apply through the military internal system. This means that volunteers can be serving military personnel or civilians seeking to join an elite unit. While there is no requirement to have any previous military experience it would be a large chasm to cross and they would be pitted against volunteers who might have frontline combat experience. The volunteers must be German citizens and be prepared to spend up to 12 years in the military if they are selected. The first step is to pass the initial selection process, which will see those who are not up to the challenge or do not pass the stringent medical examinations being rejected.

It is a day-long physical examination, as well as undertaking a simulated dive in a hyperbaric chamber to undertake an oxygen tolerance test (breathing a gas mixture with a higher than normal proportion of oxygen), as the diving equipment used by the German Navy special forces uses a higher than normal oxygen to nitrogen ratio. This is a normal test for determining an individual's oxygen tolerance and will be a 'failure' point for some candidates. Those who pass both the mental and physical tests will be transferred from their current unit or directly from basic training to a basic diving course. During this phase the volunteer is under constant assessment.

Those who pass proceed to a three-year training course in which the volunteers will acquire the knowledge and skills necessary to take up a place in the unit. Apart from combat diver training using rebreathers they will

German special forces combat divers using closed-circuit breathing equipment rise out of the water ready to insert ashore as part of a training exercise. (Photo by Alexander Koerner/ Getty Images)

become experts in commando skills and techniques, including parachuting both onto land and into water, as well as counterterrorism training, and sea navigation.

There are four weeks of introductory training where the volunteers are pushed to their limits both physically and psychologically, with an objective of removing fear of water and to make them confident. As an example, the volunteer is dressed in full combat outfit with their hands tied behind their back and feet tied together, before being pushed into a swimming pool where they must remain for 30 seconds, to then be recovered by a safety diver.

There is the 'hell week' where the volunteers are deprived of sleep by being called to participate in some activity before the normal day training regime continues. Then there is the training to exit and enter a submarine through a torpedo tube. The final challenge is being taken out to sea about 30km then, with full equipment, put into the sea to swim to a beach.

Three years of training is a long duration for the volunteer to endure and that is why those who are selected are required to serve an extended period, and with that comes promotions. Added into the three years is Non-Commissioned Officer (NCO) training elements, which allow lower ranking unit members promotion opportunities upon completion of their SF training.

Honduras

Fuerza Especial Naval

In 2013 US Navy special forces worked with Honduran troops to lay the groundwork for a Honduran special forces unit capable of combating illegal drug traffickers in the waterways and coastal areas of the country. Staff Sergeant Danny McCormick from the Beyond the Horizon Public Affairs Office reported on a team of SEALs who created and carried out a

Working with the US military, a Honduran diver prepares for a training dive. (US Army photo by Spc Trevor Franklin/ Released)

comprehensive training and maintenance programme that had previously been used in Guatemala, so as to build their Navy Special Force into a strong counter-narcotic force.

To select members of the newly formed Honduran Fuerza Especial Naval (FEN), the SEALs subjected 110 Honduran sailors to a rigorous eight-week training course similar to the one used to train US SEALs. Of the 110 that began the course, 45 qualified. US Navy special forces members also provided small boat handling and maintenance training, as well as creating a team of communication specialists to serve as radio operators.

At a training event held at the Puerto Castillo Naval Base, where Honduran Navy divers complete a tough diving exercise, the divers are given their instructions on the pier before they jump into the water, as there is no time for instructions or guidance once the exercise begins.

The divers jump into 4.5m of water and wait for their instructor to join them before submerging for the test. The instructor signals the time keeper on the pier, and three other instructors join him to attack the students. The two trainees are turned, twisted and flipped to disorient them and the instructors remove the diving gear from one of the divers until fins, a face mask and a complete air tank is removed from the pair. The two share the one regulator between them and find that the only way to stick together is to wrap their arms and legs around each other. The instructors continue to roll them, but being entangled like this allows them to focus more on sharing their air now instead of worrying about the disorienting effects of the 'current'. The instructors not only try to separate the divers, but they must also constantly pull them back to the bottom as their natural buoyancy lifts them to the surface.

The exercise is designed to build confidence between pairs of divers who find themselves stuck within a riptide or other strong underwater current and have only one air tank to share. This is the buddy system in action and this training could very well save these divers' lives should they find themselves in an actual riptide.

Two Honduran combat divers prepare to enter the water for the submergence test while training with the US military. (US Department of Defense, Navy, photo by Staff Sgt Danny McCormick)

Russian Federation

Spetsnaz

Initially, Spetsnaz personnel are all conscripts, picked by selection centres for service in the Naval Infantry, but if selected they will serve for three years rather than the normal two. They can opt to remain after the three years, and if selected for the Spetsnaz would be obliged to do so. Training begins with that of the ordinary Russian infantryman, but then moves on to specialized tuition in sea and amphibious operations – the latter being based around the concept of the beach assault landing, which is practised in both daylight and darkness, and in all weather conditions.

Potential members of Russia's Spetsnaz combat divers undergo a rigorous selection process as they operate under and in water environments. (Photo by Arne Hodalic/Corbis via Getty Images)

Physical training forms a major part of the overall programme – combined with weapons skills, marksmanship and the ability to operate effectively on unfamiliar ground – to produce an above-average soldier. The Spetsnaz select only from the best of the Russian troops, those who can undertake the specialist advanced training involved in establishing the small elite groups. Further training includes learning demolitions, underwater swimming, parachuting, and both armed and unarmed combat.

Therefore, Spetsnaz combat swimmers are selected from the very best of the Russian military, and many are chosen from the Naval Infantry (Marines), who already recruit the more superior personnel. Along with the crews of the Spetsnaz Midget Submarine Group they wear the uniform of the Russian Naval Infantry, which is a mixture of Army and Navy kit, as well as the distinctive black beret. In the field, they wear black fatigues, and a black bush-type jacket, calf-length black leather boots and a black belt. The neck of the bush jacket is worn open, displaying the distinctive blue-and-white striped T-shirt, inherited from the Soviet Naval Infantry. When in action, camouflaged clothing is worn, by virtue of the fact that the Spetsnaz wear the uniform of the Naval Infantry to preserve their anonymity as specialist covert operators.

The Philippines

Navy combat divers

Entry into the Naval Combat Diver Group is open to all officers and enlisted Navy personnel who wish to be a part of this elite group. Those who are selected undertake a two-month course, which entails both classroom and practical sessions designed to provide the students with knowledge of diving principles and concepts to become a scuba diver. Diving itself is a means to an end and allows the operator to get from a secure vessel to a target, and so the operator requires additional skills to be able to complete the mission. This means that specialist SEAL and EOD skills are undertaken in addition to the basic diver training. The training programmes are broadly modelled on other countries' units, which also allows them to participate in joint exercises.

The Naval Special Operations Command of the Philippine Navy are founded on the concept of the US Navy Underwater Demolition Teams (UDT), which allows them to conduct underwater operations in waterways, beach areas and harbours in support of Naval Operations. Apart from direct action, the operations include underwater explosive disposal, mine countermeasures, salvage, and search and rescue.

The first formal EOD class conducted was in 1995, followed by the establishment of Naval EOD (NAVEOD) as one of the units of NAVSOG in 2004, and its contributions have evolved since then, including initiatives to address new security realities and challenges. One thing that has not changed is the sending of personnel to the Clearance Diving School in India, and attending the annual Multi-National Mine Warfare Exercise in Busan, South Korea.

EOD Mine Countermeasure Team's primary mission is to conduct amphibious reconnaissance of potential beach landing sites to detect mines in very shallow water in support of amphibious operations. As a minimum, the Navy requires detection to include hand-held sonar and specialized non-magnetic dive equipment. This allows a team to conduct amphibious reconnaissance in potentially mined areas. Today, NAVEOD is to be fully capable of directly conducting mine-hunting and clearance operations. They will use specialist mine-hunting equipment, tactics, techniques and procedures (TTPs) to locate, identify, neutralize, recover or dispose of sea mines, torpedoes and other undersea weapons, including waterborne IEDs.

Aside from sub-surface insertion and extraction capabilities of the combat diver teams, they have also developed their competency in underwater works such as searching and salvaging, ships' inspection and maintenance, and other support requirements, including recompression chamber operation and treatment. Other various roles of the military combat divers include civil military operations such as disaster search and rescue activities during unplanned events.

CHAPTER NINE

COMBAT DIVER INFILTRATION OPTIONS

There are numerous options available for the infiltration of combat divers – which range from submarines, surface ships and boats, to helicopters and fixed-wing aircraft. All can play an important role in providing a flexible mode of delivery, and the method chosen will depend on a number of factors as covert operations require teams to enter enemy territory unseen, to avoid compromising an operation. There is also extraction of the divers to be considered following their mission. For example, those who deploy by parachute need an alternative means of being recovered. Moreover, situations constantly change and a plan drafted for today may well need to be adapted in a short space of time. The 'what ifs' are not considered here, so this is just a review of some methods of deploying for a covert operation where, in some cases, the enemy defences might be considered to be very limited, while other targets might be well-defended. Whatever the situation, the operatives must

Lithuanian combat divers partake in NATO training exercises with those of other nations. This allows some non-members to gain the widest possible experience and knowledge of capabilities and operations. (Photo by Mass Communication Specialist 2nd Class (SW) Jeff Troutman)

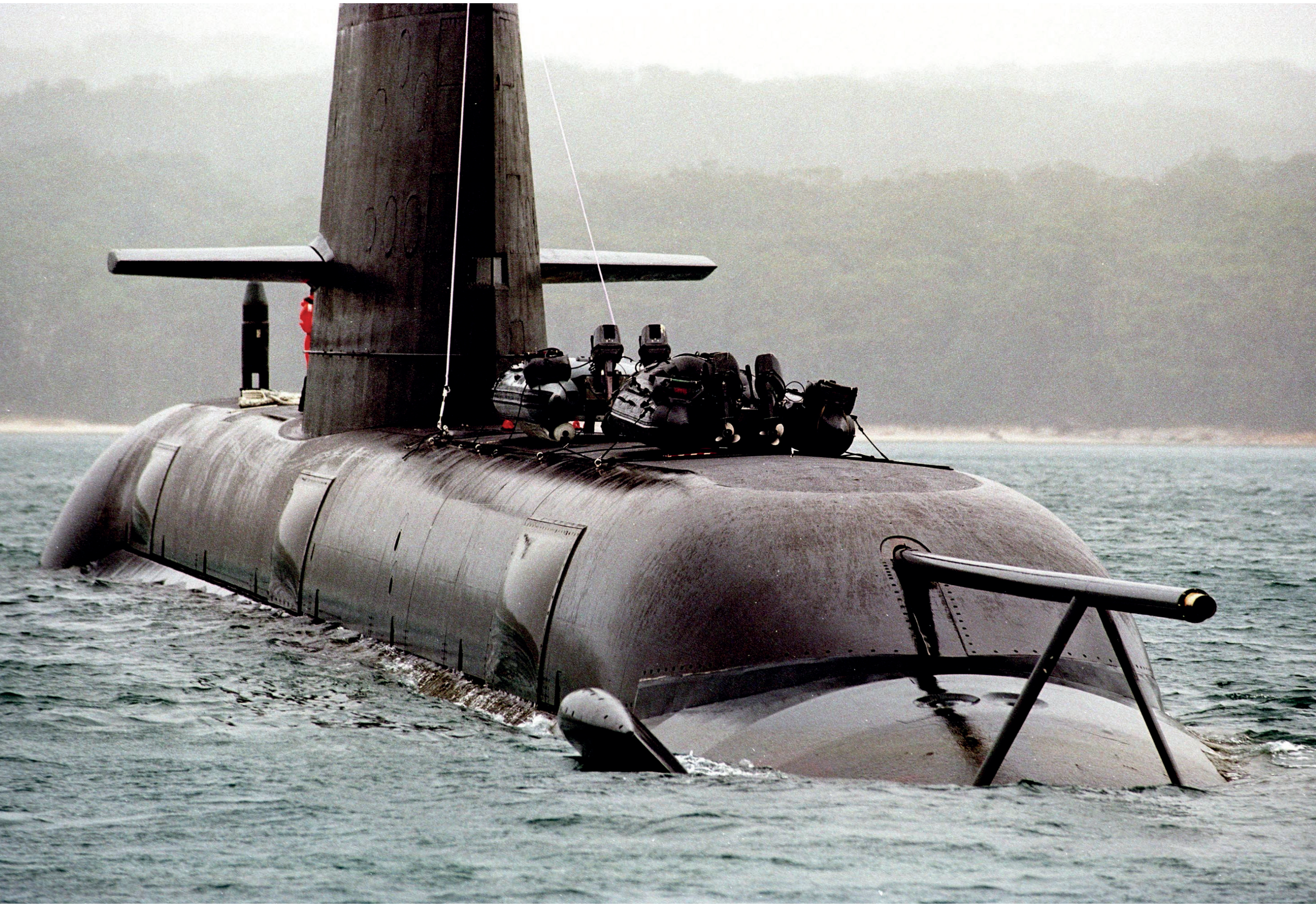
A historical view of canoes lined up on the deck of a conventional submarine ready to be paddled away once the sub has submerged enough. (Danish Armed Forces)

meet the challenges and changes that they might encounter, and for the underwater attacker limited ammunition is a constant factor, so a full engagement with the enemy will be avoided at all costs.

Submarines

The World War II raids carried out from submarines required the boat to surface and the canoes or rubber boats would be taken from within the submarine and prepared on deck. Once the operatives were in their craft, the submarine would slowly sink below the surface, allowing the craft to be paddled away. That option still remains today and is how some countries will deploy their special forces, but submarines on the surface are vulnerable, and modern radar is more effective, so the combat diver has to have more options.

Today, both conventional and nuclear-powered submarines are used for clandestine underwater diver operations, the latter having the disadvantages of being comparatively noisy and unable to 'bottom out'. This is a manoeuvre in which the submarine moves into shallow water and then sits on the seabed to allow divers to exit and re-enter, or to deploy swimmer delivery vehicles, which the larger types of submarine might be adapted to carry to a target area. Nuclear-powered submarines have cooling water intakes for their reactors set in the bottom of the hull, so require a certain amount of clear water below them. However, the nuclear boat can remain submerged for extended periods and travels faster, but as with all submarines there is not a lot of room inside for the additional people, equipment and stores.



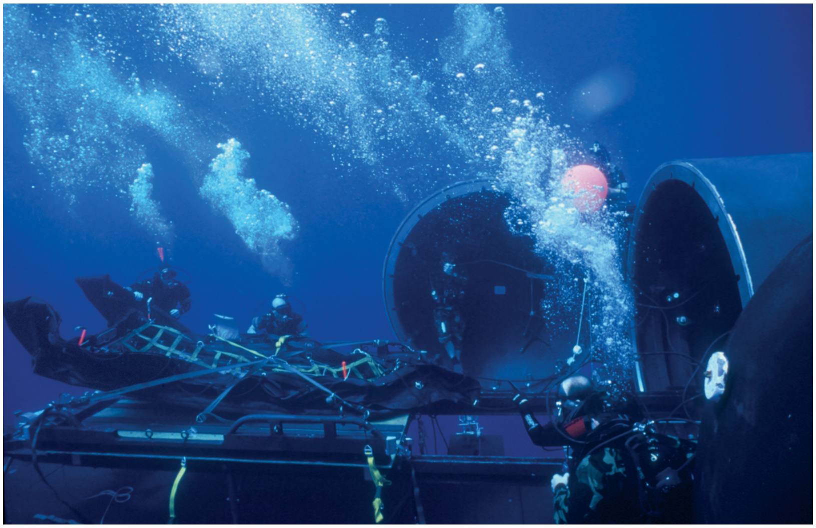
ABOVE
An Australian submarine on the surface with two inflatable boats secured on the deck, ready to be launched to carry combat divers or commandos on a covert operation. (Australian Department of Defence)

OPPOSITE
A caisson diver exits a submerged submarine. He is wearing a full-face mask with an oral nasal that will allow him to communicate with those inside the boat. (US Department of Defense, Navy)

During the Falklands conflict, SBS and SAS divers were dropped from Hercules transport aircraft to rendezvous with submarines, which then carried them to their drop-off areas at sea. All exits from submarines in the Falklands operations were done while the boats were on the surface, allowing inflatables and canoes to be used. This enabled the teams to carry the equipment and stores needed to survive and fight in the extreme conditions. There was no need for underwater covert attacks from a submerged submarine, as both South Georgia and the Falklands had vast expanses of exposed coastline which enabled the swimmers to get ashore by more conventional means of surface boats and helicopters, along with the additional stores.

The submarine HMS *Onyx* carried out a number of covert operations in the Falklands conflict. Carrying teams of the SBS it moved in close to land at night, then surfaced to deploy the inflatable boats which carried the operatives ashore, leaving the submarine free to move back out to sea again. There are numerous dangers in such operations for any submarine, and *Onyx* sustained damage to one of the torpedo tubes containing a live torpedo, and as a result

PRESSURE TESTED
D62
SEATEC



Deflated rubber boats can be carried by a submarine and inflated when the combat diver team requires them, allowing the submarine to remain submerged. (Michael Wood/Stocktrek Images/Getty Images)

had to return to the UK for repairs. When one considers the size of a submarine such as *Onyx*, whose crew of 70 are all housed in extremely cramped conditions, the addition of SBS or SAS diver teams, often in large numbers, adds considerably to the discomfort; the inside of a conventional submarine gets very hot and clammy, especially with additional men drawing on the air conditioning. 'Home' for the diver teams is in the spare torpedo stowage area, which they share with rubber boats, outboard engines, canoes and the mass of other specialist equipment. There are no bunks for them.

For this type of operation there needs to be a 'fudge factor', so it is desirable for submarine diver operations to be prepared in a dock, harbour or sheltered water, where all equipment can be checked and stowed prior to commencement of the operation, thus giving more flexibility to the team in the target area. Inflatable boats can be stowed below decks or in the stowage boxes under the casing. Canoes can be carried inside the pressure hull, assembled ready for use, but if stowed collapsed, they will be in three separate bags. British submariners are very familiar with the needs of both the SBS and SAS, and are extremely efficient at manhandling the equipment both out onto the deck and into the water, as their counterparts in the US and the then Soviet and now Russian navies are with the requirements of their own special forces. Canoes and inflatables can be deployed in one of two ways: the first requires the boats to be launched into the water, with the swimmers climbing down into them; the other method is to leave the canoes or boats on the submarine's deck, to float off when the sub submerges. The latter is quicker, especially when the captain does not want to keep the submarine on the surface longer than necessary. Recovery of either craft will be by bringing them alongside, so that the men can clamber up on to the casing, while the submarine's crew drag the boats up to the deck and stow them away or dispose of them.

The submarine will sail to the predetermined ‘drop-off’ area to deliver its cargo of specialist troops, where it will either surface to dispatch its teams, or do so while submerged. For a covert operation that requires the submarine to remain below the surface the boat will move to a suitable position and divers will enter the pressure chamber and flood it to gain access to the water outside. These men are known as the ‘caisson divers’, and their job is to remain in the lurking area where they will firstly send a buoy attached to a line to the surface, the line running close to the exit hatch of the escape chamber. The caisson divers will then remove the boats and stores from the storage boxes under the casing deck and inflate them, sending them to the surface attached to the line.

On the surface the inflated craft, with their waterproofed outboard engines, are ready for the stores to be put aboard. The number of boats used will obviously depend upon the numbers in the teams on a given operation. Once the boats are on the surface and ready, the caisson divers inform the covert operators inside. The first group enters the chamber, and begins to equalize to the surrounding water pressure. Outside, the two caisson divers stand by the hatch with the line ready for the operational divers. As the hatch begins to open, the divers outside assist with pulling it open, allowing the special forces divers to emerge and follow the line to the surface.

The first divers reaching the surface will get aboard the inflatable, and prepare the outboard engine. Each diver will be wearing their combat suit, encased in an underwater dry suit. The remaining combat divers exit the submarine and are guided to the surface where, once they are all aboard, they depart for their target, leaving the caisson divers to secure the line and hatches. The divers re-enter the submarine to await the recovery of the SF diver teams following the completion of their mission.

At the pre-arranged time the swimmers will move out to sea aboard their boats, and at the rendezvous will lower a transponder, or link up by satellite navigation, where the submarine will pick up the signal on its sonar, or communications aerial, and move in to meet them. At the rendezvous, the combat divers will be able to begin the re-entry, and the caisson divers will be ready to enter the pressure chamber. Once locked out, they will again dispatch a line to the surface with a small buoy attached. Depending on the situation the boats and stores might be recovered, and while the caisson divers stow the equipment away, the first group of divers enter the pressure chamber, and re-enter the submarine.

This process continues until all of the divers are aboard, then once the equipment is stowed and secured, the caisson divers re-enter. If at any point during the recovery the captain feels that the rendezvous could be compromised, the divers are recovered and their boats and stores discarded, after they have been suitably damaged to ensure that they sink. The submarine can then exit the area unseen and unheard.

RIGHT
US MC-130J Commando aircraft undertake infiltration, exfiltration, and resupply for SOF operations. Many nations have specially trained aircrews and aircraft available for their special forces operations. (US Air Force photo by Airman 1st Class Stephen Pulter)

Fixed-wing aircraft

Aircraft capable of transporting parachutist divers and their equipment are numerous. The C-130 Hercules is probably one of the best known and has been the workhorse for numerous years, and has been joined by updated aircraft. The main advantage of the Hercules is its short landing and take-off ability, along with being able to use rough landing strips that other aircraft can't. Some nations have aircraft and aircrew dedicated to special forces operations, as it goes without saying that aircraft crews must deliver their specialist teams to the right place, especially with water drops. These are well-tried and tested methods of deployment, and well-practised.

The downside for aircraft in the modern world is that radar and satellites capture their movements, and most countries have systems sophisticated enough to detect and track movements in their air space. Tactically it is possible for an aircraft to fly under radar tracking, but that would mean operatives undertaking low-altitude parachute drops.

An upside for a fixed-wing aircraft is the operational range and space for the operatives and their equipment, which means that special-ops divers can be inserted at long range, where time is of the essence for such operations as gathering intelligence, supporting an ongoing mission, a covert activity to infiltrate and attack a specific target, or rendezvous with a surface vessel or submarine at sea. Special forces-capable aircraft and crews will remain a viable option for a long time to come.

BELOW
Dropping a load of two inflatable boats. The aircraft can support long-range missions for deployment and re-supply. (US Army photo by K. Kassens)

BELOW RIGHT
Following a water drop, two US Army SF operatives are reunited with two inflatable boats, which they will ready to transport the team on their infiltration. (US Army photo by K. Kassens)

TOP LEFT

As the helicopter flies low, the combat frogman drops from it, along with his kit, which is sealed in rubber bags. He is equipped for swimming once in the water, and has fins fitted to help movement. (Danish Armed Forces, Hennk Palshøj)

ABOVE

An SF diver drops out of the back of a helicopter into the sea. Having no other equipment, he would be part of a team to use an inflatable boat, which can have personal equipment on board, but his rifle remains with him. (Danish Armed Forces, Christian Sudsdal)

ABOVE LEFT

A Chinook flies very low over the sea to deliver a larger assault boat. Team members disconnect a lifting strop as the craft disengages from the helicopter. A Chinook is able to be lowered into the water to flood the cabin enough for an inflatable boat to be driven in and secured before lifting off. (US Department of Defense, Navy, photo by Ensign Robyn Gerstenslager)

Helicopters

There is an increasing expansion in the use of helicopters, and experience in Iraq, Afghanistan and the Falklands has shown that even though they have noisy rotors, they are able to fly very low and fast, using the cover of undulating terrain to enter enemy territory and deposit special forces, either on land or in water. At night, helicopter aircrews use passive night-vision equipment to enable them to undertake tasks that normally would only be carried out during daylight. However, during snow whiteouts it is particularly dangerous as the aircrew cannot see anything and have to rely entirely on instruments.

Helicopters are improving in terms of survivability and endurance, and are able to deliver parachutists, free jumping from low altitude into water, or rapid roping. Modern helicopters can carry ever-increasing quantities of personnel and equipment as well as weapon systems.

ABOVE
A Chinook flies very low over the sea with a ladder deployed, allowing divers to climb aboard. (US Army photo by Capt Richard Barker/Released)

ABOVE RIGHT
A helicopter is able to deploy or recover operatives while on the move, using a flexible ladder. (Photo by Mass Communication Specialist 1st Class Lynn Friant)

RIGHT
Exfiltration of SOF is vital, and one option is to use the Stabo system where operatives are connected to a trailing rope to make the operation in one lift. (US Department of Defense)

Parachuting

All special forces troops are trained in the art of parachuting, with the most common method being the static-line drop. This is where the parachutist hooks up a line from the main parachute to a fixed point in the aircraft, so that on jumping the line pays out behind them, pulling the canopy out of its bag, allowing it to deploy automatically. If the main canopy should have a malfunction, the parachutist can use the emergency parachute, carried on the front of the body, which is deployed manually.

The advantages of the static-line method are that it is well proven, easy to learn and relatively safe. The men can carry equipment loads, with a normal drop height in the 150 to 600m range. It is a good method for undertaking 'wet' drops, and, combined with the use of a steerable canopy, can provide great accuracy when attempting to land close to stores or to a vessel waiting in the water. The transport aircraft on a covert mission would fly low to avoid radar detection, lifting up for the parachute drop at the last moment. At the minimum altitude, the men will remove themselves and their equipment rapidly, to allow the aircraft to drop back down to a safe level again. Dropping men and equipment into the sea can

Combat divers can be deployed by parachute from Chinook helicopters, which can also be used to recover them from the water. (Photo by Spc Brenda Smith/Joint Force Headquarters – Alabama National Guard)

be challenging because waves and currents create problems, the divers will not want to be exposed to a long swim, and palleted equipment is difficult to move in water.

Most mechanical items do not react well with water, so combat divers allow a 'fudge factor', which means they expect or plan for a failure of equipment or the entire operation. A malfunction with a breathing set could compromise the operation, so teams prepare for that occurance.

The result is that an operational team will require an additional payload of stores to support their operation. The failure of equipment, combined with the possible loss of stores packages dropped into the sea, creates problems which could result in an operation failing. With the divers go their canoes and inflatable boats, which are parachuted into the sea assembled and rafted on pallets. The divers can then swim to join them and cut away the pallets, which sink, allowing them to paddle their canoes away, or start the outboard engines and power their inflatable boats away.

Freefall parachutists deploy out of the rear door of an aircraft. Missing from the operative is the personal equipment that would normally be strapped to the back of the legs. (US Department of Defense, photo by Capt David Chace)

KEEP CLEAR OF

GO DOORS

The divers themselves will be dressed in underwater dry suits which are one-piece, flexible rubber suits, which seal at the neck and wrists. Entry is through the back, and then it zips closed with a waterproof zip. The divers' fins are stowed in their parachute harnesses, and can be put on once in the water. A sealed bag carries the vital equipment needed once on the operation, including the closed-circuit underwater breathing apparatus.

Apart from parachuting into the sea, divers could easily drop into a lake, possibly miles inland, where they could make use of any small islands and the normally abundant vegetation found near larger areas of water. The divers on this type of operation would probably be from the Special Air Service boat troop, and they would probably use high altitude free-fall methods. The High Altitude Low Opening (HALO) technique requires the parachutist to depart the aircraft at an altitude of some 7,500m while breathing oxygen, and to track across the sky in the free-fall position, gaining ground distance while descending. When the parachutist reaches the canopy deployment altitude, the parachute can be opened manually or automatically, to complete the descent in the conventional manner. The amount of equipment that can be carried by the individual is very limited, especially if underwater breathing apparatus is added. A team can jump with a separate stores container; however, the men have to track it across the sky then, near the canopy deployment altitude, separate and follow it down to the ground or water.

High Altitude High Opening (HAHO) is the other specialist technique which again requires the parachutist to depart the aircraft at high altitude, breathing oxygen, but differs from HALO in that the parachutist departs the aircraft, stabilizes in the free-fall mode, then deploys the canopy. This would be using a ram air wing, which permits a great deal of control and which, when used by skilful operators, can fly a man across the sky, covering a considerable ground distance. Again, this method limits the amount of equipment the individual can carry, and would require a separate container drop, or a rendezvous at a pre-sited stores cache.

Rendezvousing with a submarine at sea is a fast method of getting a team to a covert destination if a target zone air drop is impracticable. A predetermined RV is decided upon between the submarine and the aircraft, with the factors of current, wind speed and direction being accounted for. The aircraft will travel to the drop zone and make contact with the submerged boat, whose captain will have to determine whether to remain submerged, or surface to take the swimmers aboard. The submarine's fin makes a large splash on a radar scanner, including those of anti-ship aircraft, and if the captain feels that the pick-up could be compromised they will remain submerged. If it is safe, they will surface and the fin will provide a good marker for the drop aircraft. The boat can also discharge a smoke flare to aid identification, and at night illuminating flares could also be used, not only for the aircraft to align on, but for the diver/parachutists to steer towards.

PREVIOUS PAGES
US Navy SEALs prepare to undertake a HALO deployment from a C130 Hercules aircraft to the sea. The divers have their closed-circuit breathing apparatus in place ready to use once in the water. If a boat is deployed, it will be a separate package. (Stocktrek Images, Inc. / Alamy Stock Photo)

With the boat on the surface, and virtually stopped, the only forward movement being that needed to keep some form of headway, the divers will be dropped so that they can make use of their steerable parachutes to control their descent to land as close as possible to the submarine. The separate stores containers cannot be steered, and so the skill of the aircrew is needed to drop them at the best position to ensure that they enter the water close to the boat. Members of the submarine's crew, conversant with covert diver operations, are able to assist from the deck in getting both men and equipment aboard and stowed below as quickly as possible. It is possible that the section's inflatables or canoes will be dropped ready to use; if they are, the teams can get them aboard and manoeuvre them into the submarine more quickly.

Raiding craft

The range of craft available to special forces divers is ever expanding, from the long serving canoe and rubber boat, to sophisticated swimmer delivery vehicles and mini-submarines (the last two are discussed in Chapters 12 and 13 respectively), to larger surface craft that can operate inshore and in rivers, and are equipped with heavy firepower.

Some countries' special forces have within their ranks dedicated raiding craft operatives who provide support to those undertaking the mission. Craft of various types and sizes can be deployed from amphibious landing ships, and in fact from any ship that has the means to lift them into the water and recover them. As identified above, they can be parachuted from aircraft or helicopters into water, along with their crews.

BELOW LEFT
Fast small craft infiltration with the operatives ready for action. (US Department of Defense, Naval Special Warfare Command)

BELOW
The classic inflatable boat being manoeuvred using paddles. The outboard engine is available, but for some operations being quiet might mean silent propulsion and hard work for the operatives. (US Department of Defense, Naval Special Warfare Command, photo by Pfc Brian Bekkala, 31st Marine Expeditionary Unit)

There is a move for some military equipment designers to multi-task larger craft that can travel on the surface and then submerge to travel underwater, carrying the combat divers to the target. The lines cross between a surface raider and swimmer delivery vehicle but it is a matter of thinking outside the box with innovation.

RIGHT
Larger raiding craft can be delivered by parachute to support ongoing amphibious operations. (US Navy photo by Mass Communication Specialist 2nd Class Jayme Pastoric/Released)

BELOW
The US Navy has boats designed for river support of special forces operations, with fast extraction and heavy fire support. Such vessels came into their own in the Vietnam War. (US Navy photo by Petty Officer 2nd Class Joseph M. Clark)

CHAPTER TEN

ANTI-TERRORISM AND PIRACY

The two main threats to maritime operations – terrorism and piracy – both use aggression to take over a vessel, and, in the case of terrorism, the focus is on the perpetrators' cause and they will freely kill and maim to achieve their demands. The terrorist could capture or attack a vessel that has a hazardous cargo, and either take it to a specific location or blow it up. In contrast, the pirate seeks to capture a target vessel and hold the crew for ransom, or steal the cargo. The pirate will use violence to attain their goal but might be considered less dangerous than the terrorist. Whatever the situation, and however the attackers are classified, lives, vessels and cargoes are at risk, and as land-based terrorist activities become more difficult, the maritime threat could well escalate.

In May 1972 the *Queen Elizabeth 2* (*QE2*) was in the Atlantic, having left New York bound for Southampton, when a phone call announced that bombs had been planted on board and that a ransom should be paid before the location of the explosives would be given. The ship had a full complement of passengers and crew, so rapid decisions had to be made, and the first act was to deploy RAF Nimrod aircraft to remain over the ship, both to monitor the ship's progress and control a rescue operation if the threat were carried out. The next decision was quite simple: if there were bombs on board then the priority was to get bomb disposal men on board and render them safe, or at least contain the explosion to a known area, for the crew's search had revealed nothing out of the ordinary. An RAF Hercules C-130 transport aircraft departed from the UK carrying four EOD experts. Two men were from the Royal Marines Special Boat Service, one was from the Special Air Service Regiment, and the fourth was from the Royal Ordnance Corps; the latter was not only making his first parachute jump, but making it into the Atlantic Ocean. The men jumped in pairs, the SBS men first, the SAS and Ordnance men second. Watched by crew and passengers on the liner wallowing in the Atlantic swell, the four men were picked up by the ship's boats, along with their equipment, and taken aboard the liner. A detailed search of the ship found no bombs, and the phone call was put down as a

hoax, or as being made by somebody hoping that a payoff would be made against a threat.

At sea, the terrorist and piracy problem is totally different from that on land and, to some extent, it is to the advantage of the terrorist or pirate. In 1985 Arab terrorists struck another blow at the maritime industry when the Italian cruise ship *Achille Lauro* was seized. The crew and passengers were held hostage for two days, and subjected to a campaign of terror, culminating in the murder of a disabled American passenger, Leon Klinghoffer. A US Navy SEAL team was placed on stand-by and began preparations to carry out an underwater rescue mission, which could have involved the use of a shaped explosive charge to cut their way through the ship's hull, or fast boat and helicopter insertion if the ship did not stop. In the event, the terrorists negotiated for the ship's release, negating the need for combat swimmers and underwater vehicles.

The *QE2* undertook two chartered cruises through the Mediterranean to Israel in commemoration of the 25th anniversary of the state's founding and this raised the threat level of a terror attack against the ship. Following intelligence it was feared that there could be an underwater attack by divers while in port and the SBS joined the ship to scour the hull for any devices. They then put away their diving equipment, donned civilian clothes and mingled with the passengers, their personal armament hidden, but ready to use. Each time the vessel docked, the swimmers would keep watch and ensure that nothing was planted on the ship that could jeopardize the safety of those on board. It would be wrong to visualize a high life for the men, attending parties every night, for the terrorist will strike at the enemy's weakest point, and that would be when the revelry was at its peak. It would be then that the SBS men would need to move into action, either on board the ship, or by having to endure long periods of time under the water, searching for mines or other explosive devices.

In recent years a new and very vulnerable target for the terrorists has begun to appear, in the form of offshore gas platforms in the southern sector of the North Sea, and later, oil platforms in the northern sector of the North Sea. These structures come under the jurisdiction of the police, namely the constabularies of Great Yarmouth in Norfolk and Aberdeen in Scotland, as these steel and

A Danish frogman leaves the water to gain access to the target with his weapon on his back and his arms free to climb. (Danish Armed Forces, Allan Overgaard)

A NLMARSOF frogman climbs a lightweight flexible ladder as part of an infiltration operation. (CONTINENTAL/ AFP via Getty Images)

concrete islands are part of the UK. The number of structures has increased over the years, and in the northern sector they have become larger, with more people living on board, resulting, in security terms, in a bigger problem. The control of manpower going offshore is limited by the large numbers of men involved, and the oil companies look at the commercial aspect of the operation first, so that terrorism is regarded like any other emergency, to be dealt with as and when it happens. With a work-force that includes a lot of sub-contracted labour from a considerable number of nations, who have neither work permits nor authority controlling them, the problem was very real.

One incident that I was involved with was on an offshore oil rig: a new diver joined the civilian diving crew, and from the start he showed a great deal of keenness as he enquired about the make-up of a rig, and was in turn shown the various construction drawings, from which he made sketches. He was also able to procure other useful information about platforms, their workings, gas and oil output, and manpower numbers, all of which he carefully noted.

A discreet investigation revealed that he had worked in Scapa Flow, Scotland, undertaking underwater demolition, so was very familiar with explosives and the storage of such material. Observations noted he had with him a collection of manuals on the subject of explosive demolition. There was real concern when he openly stated that he had served in Long Kesh prison in Northern Ireland, and was a supporter of the IRA. The facts were immediately notified to his employer in Aberdeen, whose only action was to shrug the matter off and remove the man and place him on another rig. The company was bypassed and details were quietly passed to the security service. After the diver departed the platform by helicopter I was informed that he was met by three men in civilian clothes and escorted to a waiting car and taken away. As with most security matters there was no communication as to an outcome.

In the UK, the SBS were at the forefront of the threat to the oil and gas rigs and would carry out dramatic exercises in retaking a structure from the 'terrorists', and handing them over to the police. They could approach the rig or platform underwater and surface among the steelwork of legs and bracings, then deploy a flexible wire ladder up to a low-level walkway. They would climb the ladder and, leaving breathing apparatus and fins, move with weapons ready up towards the accommodation. One option would be to access the platform using an inflatable boat and use the flexible ladder. Another option would be to arrive by helicopter, flying very low over the sea, to rise up at the last moment and hover over the helipad, allowing the men to fast rappel to the deck. As the last man reached the deck, the helicopter would fall over the side towards the sea then fly away, keeping low. This deployment is from start to finish very rapid, and the well-armed special forces team is soon inserted.

It would be prudent to assume that terrorists are being trained in the use of specialist equipment and diving training. The manufacture of underwater bombs or mines is easy for the terrorist organization which has experience of doing it on the surface. It really only means waterproofing the bundle, and that can be done with a plastic bag and some duct-tape. There is no need to go to a great depth, and a raid can be carried out by competent underwater divers.

An article titled 'Terrorist's Underwater Strategy', dated 22 March 2005, from The Institute of Peace and Conflict Studies (IPCS) referred to a Philippine military report which is said suggested that two Al Qaeda-linked groups had been undergoing training in scuba diving and that this training was believed to be preparatory to carrying out underwater attacks on maritime assets in ports and harbours. The Philippine report also claimed that the Indonesia-based terrorist group Jemaah Islamiyah had financed an Islamist separatist organisation, Abu Sayyaf, with $18,500 for explosives training in 2004 and that the purpose was for a bombing plot on unspecified targets outside the Philippines. The IPCS article states:

> The capture of Abd al-Rahim al-Nashiri, an alleged mastermind of Al Qaeda's nautical strategy, revealed that Al Qaeda could use small submersibles, underwater motor-propelled sleds that divers use and 'human torpedoes' to carry out underwater attacks. Apparently as a result of confessions by Omar al-Faruq, a captured Al Qaeda operative, it was revealed that he planned scuba attacks on US warships in Indonesia…

Gary Hicks, vice-president for operations of the naval and maritime solutions business unit, of research and engineering firm SAIC, pointed out the ease with which potential terrorists could receive training in underwater activities using scuba and rebreather technology. Hicks stated:

> Re-breather technology is available commercially and that training is available in many countries. Even marginally trained combat swimmers can be successful… To have a significant impact on most large vessels, a relatively large quantity of explosives needs to be carried, which presents logistical problems for the swimmer, especially in strong currents. Nevertheless, a strategically placed charge could cause damage and difficulties for cruise ships, naval vessels or even a single-hulled tanker. Larger explosive charges could theoretically be carried by underwater vehicles such as mini-subs.

The IPCS is of the opinion that terrorist groups have developed the capability and expertise to carry out underwater attacks against maritime assets and that this capability may have been obtained from the Liberation Tigers of Tamil Elam (LTTE). To achieve their aim of obtaining a separate Tamil homeland in Sri Lanka, the LTTE developed a strategy of attacking Sri Lankan Navy ships and commercial vessels, and the IPCS reports that

> Sri Lanka has lost at least a dozen naval vessels, both in harbour and at sea, as a result of LTTE attacks… The Maritime Intelligence Group, a Washington-based think tank, has also noted that members of the Jemaah Islamiah had been trained in sea-borne guerrilla tactics developed by the LTTE… Limpet mines are an attractive choice for carrying out attacks.

Although the threat from Tamil Tigers has receded there is an ongoing terrorism threat to British shipping, which was highlighted in a media article by Martin Beckford, Home Affairs Editor for the *Mail on Sunday*, published on 20 May 2017, stating:

> Special Forces frogmen are searching for terrorist mines attached to the vast tankers that ferry gas from the Middle East to Britain, the *Mail on Sunday* can reveal. Members of the Special Boat Service (SBS) and specialists from the Royal Navy are conducting the covert searches amid growing fears that Al Qaeda or Islamic State terrorists might attach explosives to ships in the Middle East and detonate them when they reach the UK.

An unnamed source added:

> The threat against gas tankers emerged a couple years ago and we have been training to counter it ever since. The concern is that tankers could be sailed into UK waters and destroyed either with mines or improvised explosive devices [IEDs]. It is entirely possible a major

> incident could result in fuel shortages in the UK and this would be disastrous economically.

The article concludes by stating: 'A Navy spokesman said it did not comment on Special Forces or ongoing operations.'

An article in RTL News on 14 November 2019 provides the foundation for the following view of the Dutch Marine Special Forces combat divers carrying out an underwater mission in arduous conditions.*

The Gulf of Aden follows from the Suez Canal and the Red Sea, and for years was well known for pirates terrorizing commercial shipping – boarding to steal cargo, and take hostages. They would get alongside cargo vessels, and use ropes to climb aboard from their small, fast boats, then use violence to take over the vessel and hold the crew hostage, demanding a ransom from the ship owners. The pirates were drawn from Somali fishermen, who had seen their fish yield decline and blamed that on foreign ships that had cleared the seas of fish stocks around Somalia. They found that the small fast craft they used had a limited range, while their target vessels were further out to sea, so they established and operated larger vessels to act as a seaborne base from which they could operate. To counter the activity many countries sent warships to the area and helped the merchant ships navigate through the dangerous area, but were limited as to what direct action could be taken. It was in such a preventative role that a team of Dutch Marines Special Forces combat frogmen were to utilize their specialist skills.

The piracy reached a peak in 2008, and had become an international concern. In the beginning, navies deployed warships with boarding teams that would attempt to intercept and prevent the hijackings. Intelligence information identified that the pirates were attacking from larger vessels used as floating bases, but rendering them inoperable was not a straightforward process, as the pirates held hostages on the vessels while they went about their business of looting and blackmail, leaving the warships and their formidable firepower ineffective.

The Hr.Ms. *Zuiderkruis*, a Dutch Navy replenishment ship, carried a team of Dutch Marines Special Forces combat frogmen tasked with planning attacks on the pirate support vessels without harming the hostages. In fact they successfully did so five times, and the following is one of those assaults.

In 2011 the target was a heavily armed Somali pirate ship, which accommodated several small fast boats, a number of pirates and 11 hijacked Iranians. The Dutch Marines could not attack the vessel directly, as the hostages could be killed if the boat sank, or shot if troops stormed it as a surface raid. The audacious plan was to put the ship out of action by using Netherlands

* The source is rtlnieuws.nl: 'Mariniers bekroond voor saboteren piratenschepen: Explosieven zaten in wasnetje' (Marines rewarded for sabotaging pirate ships – explosives were in a laundry net)

LEFT
A NLMARSOF combat frogman in full operational diving equipment. (JLBvdWOLF / Alamy Stock Photo)

BELOW
Dutch combat frogmen use a jet ski as a mode of transport as either a two-person option or one driver and two combat divers for a mission. (NLMARSOF)

Marine Corps Special Forces frogmen to make a covert underwater attack – to place explosives so as to disable the ship, but leave it afloat. Once disabled, the vessel could not operate and the small fast boats would be out of action. The planning had to be meticulous, as the divers needed to get close enough to operate, but without being seen or heard, and then be recovered once they had accomplished the attack. But this is the real world of the underwater warriors.

The Hr.Ms. *Zuiderkruis* moved as close as it could to the pirate vessel, under cover of darkness, before launching a special forces jet ski to carry a driver and two combat frogmen using closed-circuit rebreather equipment. Apart from being fast, they are semi-submersible, meaning that they partially sink in order to reduce their radar signatures and chance of visual sighting. The frogmen carried with them two explosive charges designed to do damage, but not blow a hole in the vessel. The assignment was clear: disable the vessel without sinking it and injuring anyone.

Having set their course, the men made good speed in the heavy swell. Had they been detected at any time the pirates would have opened fire on them, and the vessel's engines started, so that it could move away – which would be high risk for the frogmen underwater, close to a moving ship and its propellors at night.

The two frogmen – Sergeant Major Harm and Sergeant Tim – would have liked the night sky to have been as dark as possible, but it was a full moon and a clear sky. Regardless, they pressed on to the drop-off point, where they departed the craft, leaving it to clear the area and allow them to continue to swim to the target vessel, which was at anchor. There was no shelter from the swell, and there are very few places on the hull of a vessel where you can attach an explosive device, and as they only wanted to disable the ship, the only option would be the propeller or the rudder.

In a swell and at 1.5 metres below the water this is the only place where a frogman has a chance to hang on by using their legs. However, the swell moves the stern up and down quite violently, so if a frogman does not go with the movement they could find the ship coming down on top of them. They also have to protect their breathing equipment, because if it becomes struck this might make it inoperable and force them to the surface.

In such a situation, to keep hanging on while holding onto the explosives is for many impossible. The divers struggled and tried to clamp their bodies in place with their legs, but the current pushed them off the ship, and the diver with the explosives lost one of the charges when it slipped from his hands and disappeared into the current – but he had one more chance. The second explosive charge would not stay in place, but giving up was not an option, and as divers are very innovative he managed to place and secure the charge on the ship. After more than an hour and a half both were able to extract themselves clear of the ship, while remaining underwater, their potentially deadly package in place and set on a timer.

During the operation the frogmen encountered other issues, such as the electronic shark shield around one frogman's leg, which gave a small electric shock to scare off sharks, but which, with every crash against the moving ship, gave the other frogman an electric shock. The frogmen were also blinded by luminous plankton, which is a problem in those warm areas of the oceans, so that they could not see what they were doing. That is why frogmen training is done in water with limited or no visibility, so they get used to doing things by touch alone. In this case they were unable to read the gauges to see how much gas they had left. Visibility and gas concerns are constant issues facing combat divers, and the thumping noises they hear coming from within the vessel always sound much louder when underwater, and in this instance could have been somebody doing a small engineering job. Added to all of that, the area was home to sharks and orcas (killer whales), but thankfully they encountered neither.

Having made good their escape from the target, they swam underwater for some 20 minutes before they surfaced to send out a GPS signal to Hr.Ms. *Zuiderkruis*, so that their location could be identified and they could be picked up. One of the two radios they carried did not work, but fortunately the other did, and the frogmen were located and recovered to be taken back to the ship. They felt the detonation as the explosives did their work, and the next day they were able to fly in a helicopter over the area to see the results of their mission. The target vessel was subsequently towed ashore, beached and cleared of pirates and hostages. It was a classic example of the value of frogmen in action, and the professionalism that is required, and places the Dutch special forces frogmen among the best in the world.

A Dutch combat frogman with a net laundry bag containing the explosive charges used to disable an enemy dhow. (NLMARSOF)

Four special forces members received a Cross of Merit for their brave actions. Three Marines also received an Honorary Badge for Merit in Silver for their significant part in conceiving and planning the unique operations.

Many countries' special forces are well versed and trained to deal with maritime terrorism and piracy. The nature of the underwater units cherishing secrecy about their involvement is well founded and has to remain secret, and the public will probably never know the extent of diver involvement in terror and piracy operations because it is a method of attack that has enormous implications if successful. The problem arises in the fact there are few special forces divers in the first place, and those there are also have other duties involving land warfare, such as Iraq and Afghanistan. The only certainty is that maritime terrorism and piracy will not go away.

CHAPTER ELEVEN

MINE AND BOMB DISPOSAL

Every navy in the world will have specialist divers trained to deal with underwater mines and explosives. They might not be classified as 'special forces' but they are generally part of a maritime special forces unit and will provide support in maritime anti-terror, piracy and enemy military attack operations. Such units are generally small when compared with the tasks they are given, and while some might serve on mine countermeasure vessels, others will be located at onshore bases ready to deploy to wherever they are required.

Terrorists, dictators and rogue states use bombs and mines as part of the continued war on others, and in most cases it is civilians that bear the brunt of such activities. In the maritime world the threat of such devices remains present, but is not at the top of public awareness until something goes bang.

There are two options when a mine-hunting vessel detects a mine at sea. The first is deploying divers who would move to its location using an inflatable boat, whereupon a clearance diver would enter the water and descend to the

A mine floating on the surface can be disposed of by placing a charge on it, then moving clear to detonate it. If a ship strikes the horns visible on the mine, it will explode. (US Navy Photo by Mass Communication Specialist 2nd Class Nick Bauer)

spot indicated and search for the object or objects, and when found would mark them off with a surface line attached to a small buoy. This enables them to be easily located when the divers have to deal with them. The diver would be wearing a diving suit and breathing set that is completely non-magnetic, as a precaution should the mine be a magnetic type, so rubber, plastic and phosphor bronze for the metal parts are used. Once the mine is identified the diver places a charge on it, and after leaving the water and getting well clear, detonates it.

Alternatively, a remote-controlled vehicle could be launched to place an explosive charge, before moving clear and the charge detonated. Because of the large number of mines that would be laid in a conflict zone, sweeping tactics would be used before individual mines were sought and disposed of, but many mines are placed in locations where conventional sweeps might not find them.

The limpet mine

A major role for clearance divers in all navies is in the defence of ships, and the removal of any devices that the enemy may place on them. The most favoured type of diver-delivered mine is the magnetic limpet, which is placed against the steel hull, leaving the timing mechanism to detonate the charge long after the diver has gone. Named after the aquatic snail which is hard to remove from rocks, the limpet mine is not usually used to sink a ship, only to immobilize it. When a diver searches for and finds such a device, the first task is to try to identify it, then to leave the water and advise the Diving Officer (DO) of its location and description.

The Diving Officer then has to make a critical decision, as it is not known when the mine will detonate and it is possible that there will be more than one device to deal with. Limpet mines can be fitted with an anti-handling mechanism, so pulling the mine off is not a practical solution. It might be possible to slide a thin sheet of steel down between the hull and the mine, but that still has a risk of detonation. The preferred option will be the Limpet Mine Disposal Equipment (LMDE) which works on a similar principle to the tracked unit used by the army on land. It is composed of a disruptor system mounted in a stand which the diver locates over the mine and attaches to the hull or structure using magnets. It has buoyancy blocks fitted to the stand to assist the diver with its handling and placement. The system would normally be prepared on deck or land then positioned over the mine, where the barrel can be accurately adjusted and positioned against the target. When fired, the LMDE projects a high velocity 'slug' of water into the mine via an electrically initiated cartridge, which is fired when the

An EOD diver on a training exercise to remove a limpet mine from the hull of a ship. (US Navy Combat Camera Photo by Petty Officer 2nd Class Daniel Rolston)

diver is clear of the water and the area. The water penetrates into the mine and washes out the explosive and the detonation mechanism so as to render the mine inoperable. If it detonates it will kill, even if the diver is not very close to the explosion. A 0.45kg scare charge used in anti-diver operations can kill.

The problem of defending against limpets is enormous when considered against the vast volume of shipping and steel structures on and in our seas and oceans, when all could be at risk. Military ships are high on a target list, so they post lookouts on deck to observe the water for anything out of the ordinary when in a risk area, for example: a trail of bubbles reaching the surface; the head of a diver breaking the surface to get sight of the target; or an item of garbage that is moving against the current and could be concealing a diver. That has to be balanced against a marine animal such as a seal which will often break the surface to 'have a look around'. If what is seen is suspicious, then a concussion hand grenade, which produces a large blast wave but little fragmentation, could be dropped close to where the target was seen. The effect of such a grenade underwater is a pressure wave that would injure or kill a diver.

When the alarm is raised on a potential target ship, divers are deployed in pairs to quickly search the ship's hull from the waterline down. Two EOD divers would be deployed to search the parts of the vessel that would be attacked, such as the steering gear – rudders and rudder posts – and the propulsion elements – shafts and propellers. If anything is found then personnel would be removed from the vessel and the surrounding area to a place of safety while the EOD divers assess the device. Then the team will begin the process of rendering it safe, while not knowing how much time they have before detonation.

A combat diver places a magnetic mine onto a pipeline. (Michael Wood/ Stocktrek Images/Getty Images)

By design, limpet mines use the advantage of being surrounded by water to accomplish their task. When placed onto a ship's hull underwater, the limpet has a dense volume of water behind it which helps direct the explosive blast into the hull or object, which, like all types of energy, seeks the path of least resistance, meaning more of the explosive force goes into the ship itself, compared to the same explosion in air.

In 2019 the US Navy claimed that Iran was behind an attack on two tankers and were able to identify Iranian limpet mines from fragments left behind:

> Fragments recovered from one of two tankers crippled by explosions in the Gulf of Oman last week bear a 'striking resemblance' to limpet mines that Iran has previously displayed, United States Navy officials told reporters on Wednesday in the United Arab Emirates… The United States has blamed Iran for the attacks on 13 June 2019 which targeted the *Kokuka Courageous*, a Japanese-operated vessel, and the Norwegian-owned *Front Altair*… During the briefing in Fujairah, United Arab Emirates, Navy officials displayed debris and a magnet that they said had been left behind after the attack on the *Kokuka Courageous*, according to Reuters… 'The limpet mine that was used in the attack is distinguishable and also strikingly bearing a resemblance to Iranian mines that have already been publicly displayed in Iranian military parades,' said the head of an explosive ordnance disposal diving and salvage task group in the Naval Forces Central Command… 'The damage at the blast hole is consistent with a limpet mine attack…'*

Sea mines

With a sea mine the naval EOD diver will be working with a large quantity of high explosive but also face the threat of booby traps. Some may well be historic devices from World War II, found floating or dragged up by fishing nets, meaning the location can vary from alongside oil pipelines to close to popular beaches.

Historic sea mines are frequently dealt with in the United Kingdom and it is the task of the Royal Navy's diving branch to respond to an emergency call. The diving teams for these operations are based in naval bases and equipped to answer the call by road or helicopter, and with them in their transport goes the underwater diving and mine removal equipment. Through the Tri-Service organization of EOD, the Navy, along with the Army and Royal Air Force, have teams ready to react. The Navy usually deals with a mine washed up on a beach or brought up in a fisherman's net, but if a Royal Engineer EOD team with divers is available in the area they could tackle the problem as it all boils down to a spread of limited manpower over a large area.

* *New York Times*, 19 June 2019

A helicopter delivers the EOD diver into the water to deal with a sea-mine. (Australian Department of Defence)

Bombs and mines of World War II vintage are well known, and the EOD diver has a lot of background and training to allow them to deal fairly safely with them, but a modern, unknown device would require a more cautious approach. On the surface, video cameras can survey an object long before the human has to approach, but under the water, in mostly black, murky, muddy conditions, the diver will have to grope around, defining the object by touch.

Navaltoday.com reported in December 2020 that:

> Fishermen in Scotland called the Royal Navy Northern Diving Group in December 2020 who are based at Faslane after they hauled up a German WW2 mine in their nets on board their trawler. The fishermen were transferred to another vessel and moved clear of the boat. When the divers arrived at the boat they used photographs to identify the mine type and were able to determine that it was intact and could be detonated in a controlled explosion. The divers then lowered the mine to the seabed and having placed explosives detonated it in a controlled explosion, sending a massive volume of water and mud into the sky. The divers stated that large mines are relatively uncommon; however, the group are approaching 100 call-outs in a year supporting civil authorities with all types of Explosive Ordnance Disposal, that range from mines and torpedoes to hand grenades to improvised devices.

Sea mines are deployed to provide a defence to a port or strategically important onshore target. Most of these mines are anchored to the seabed, which allows them to float on, or just below, the surface, but if the cable holding them breaks then the mine becomes free floating and becomes a danger to all shipping. In such instances a warship is dispatched and the mine becomes a target for weapons practice and guns shoot at it in an attempt to detonate it. If a surface ship is not available then a helicopter can deliver an EOD diver close to the mine, who can swim to it and place an explosive charge on it. Once the diver is winched back into the helicopter and well clear of the mine, the charge is detonated and the resulting explosion removes the threat the mine posed. It has been known for sea mines to be deposited to float free in international shipping lanes, which means that such weapons pose a serious and indiscriminate risk to shipping.

Mined beaches

Beaches are defended with the use of anti-personnel and anti-tank mines, particularly those which offer landing areas to an enemy amphibious assault. For those wanting to land on the beaches information will be sought as to the suitability of landing vehicles up to and including tanks, and also about what defences lie beyond the beach. Above-surface obstructions can be seen and identified but mines are buried and unseen so combat divers are required to survey the beach and clear an area from the waterline to the beachhead. Those areas are then marked so that landing craft can put their troops ashore with the knowledge that the route is clear of one lethal defence.

Anti-landing craft and tank defences can be fitted with explosives so that anything hitting them detonates the explosives with considerable destructive power. These can result in the loss of valuable people and equipment. The combat diver can use prepared shaped explosive charges to level such structures prior to the actual landing. However, the structures can be linked to buried mines which also detonate in an attempt to cause as much damage as possible.

ABOVE LEFT
An Australian EOD CD practising searching for and removing mines on a beach. Operationally, combat divers would be in diving equipment. (Australian Department of Defence)

ABOVE
Danish frogmen secure a beachhead to cover the activity of those searching for mines. The net covering the head helps to break up the body outline. (Danish Armed Forces, Henrik Palshøj)

LEFT
CDs undertake a survey searching for any mines or obstructions that could affect an amphibious landing. (Australian Department of Defence)

ABOVE
These photos show the destruction of mines and obstructions to clear the way for a landing. A beach will have numerous mines in place. (Danish Armed Forces, Anders Fridberg)

Demolitions of mines and beach obstructions are dramatic, as well as being lethal if not located and disposed of. This task will be undertaken by combat divers who reach the beach either underwater or by swimming on the surface in the hours of darkness.

While divers search for mines and explosives on the beach others will have moved forward to provide a defensive cover for them. If the enemy arrive in sufficient numbers all of the divers might have to depart in haste, as they will not have sufficient equipment or ammunition to provide a strong defence, and there will be an orderly departure back into the sea. If the enemy arrives as a small patrol the divers might have the option to dispose of them, allowing the mine operation to continue.

Beachhead explosions are more dramatic and can include the demolition of mines, other explosives, anti-armour and vehicle obstructions, and other defence targets. This is important because when the amphibious landing takes place the assault troop have to get clear of the beach as quickly as possible, and have vehicles with heavy weapons with them as they push inland.

Up until the detonations of explosive charges the mission will be covert, at least within the limitations of an amphibious landing that involves a number of ships carrying troops, vehicles and equipment approaching within striking distance. Those clearing the beaches and gathering intelligence beyond the beach will not want to engage the enemy unless there is no option. This means that once all charges are in place the combat divers will leave the beach to a place of safety. They will be involved again once the landing is in motion, when the explosives will be detonated and the beach markers put in place. Naval gunfire teams will infiltrate ashore before the main landing to identify targets and at the appointed hour direct naval gunfire onto enemy forces and armour. The landing craft will be guided into safe zones to disembark their troops.

RIGHT
If the divers on the beach require support, boats with heavy machine guns can be called to provide firepower. (Danish Armed Forces, Casper Tybjerg)

CHAPTER TWELVE

SWIMMER DELIVERY VEHICLES AND DRY DECK SHELTERS

The purpose of the swimmer delivery vehicle (SDV) was to transport a diver over a distance faster than he could swim to get to a target, and allow him to carry a payload greater than would be possible by the swimmer alone. With this type of vehicle the diver and controls are open to the surrounding water and, with early craft, getting good seals on the waterproofed equipment was a challenge. Battery power was also a limiting factor because they were large and heavy when compared with what is available today. The size of such craft varied from the two-man basic unit to the four- and six-man vehicles, which were more complex units. The divers then, as today, either lie or sit, on or in the vehicle while it moves through the water, and are dressed in their underwater drysuits or wetsuits and breathe through either an onboard open-circuit breathing system or their individual closed-circuit rebreathers.

The larger and more complex 'wet' SDVs evolved to carry four or six divers, with a reasonable payload of weapons or stores. The additional batteries helped increase the speed and range of the larger vehicles, which enhanced the operational and flexibility requirements of the diver teams, and allowed them to carry additional underwater breathing equipment. These larger vehicles were carried to the target area by a parent submarine, which allowed the divers to transfer while submerged, thus not risking compromising the operation.

The range of operations that could be undertaken by these vehicles was considerable. They could carry divers into a harbour or dock area and act as a base – as was the case with the incidents that occurred in Sweden (see Chapter 5). In an aggressive mode the divers could clamp limpets on any number of targets, returning to the vehicle for more mines when needed, and finally use it to exfiltrate themselves from the area. Carrying divers underwater allowed them to slip into enemy-held territory unseen and unheard, or the divers could be dropped off and the vehicle set down on the seabed while the divers swam ashore to land under cover of darkness, to move inland to undertake a task. When completed, they swam out to the vehicle and made good their exit.

Special forces divers found the vehicles of great use when undertaking beach survey and reconnaissance, for they could remain unobserved, apart from exposure on the tide line. The flexibility of the vehicles would enable a number of beaches to be surveyed in the time it would normally take to do one. The advantages of these craft in an amphibious landing are in surveying the suitability of beaches for landing craft access, identifying any defences that might cause concern, and if the vehicles could be landed. Before the landing, the divers would lay beacons on the seabed and beach, which the landing craft or assault vessels could follow, providing them with a clear passage, especially in darkness, and allowing rapid deployment of the assault forces ashore. Over the years the operational capability of the SDV has been governed by the divers' underwater breathing duration and depth limitations, but progress has allowed the diver to have breathing gas options available to them today.

As far as is known, no swimmer delivery vehicles were used during the operations in the Falklands conflict. A number of reasons can be put forward for this, and one could be the speed of mobilization of the Special Boat Service, whose members were the first elements to depart south, and who undertook wet parachute drops to rendezvous with submarines. The next reason could have been weather conditions, for the majority of SDVs leave the swimmers open to the sea and operate in shallow water and at a constant depth. The sea state was unpredictable and could have jeopardized both craft and swimmers. Kelp was another problem that could have influenced the decision, as very prolific beds of long fronds surround the islands.

A number of important factors have been raised on present swimmer delivery vehicles and their future development. The principal factors are that they must be small and lightweight, capable of relatively high sustained cruise speeds and undertaking long-range operations. They need the ability to operate away from a parent craft or support unit for extended periods of time, combined with the considerations needed for the deployment and recovery of the vehicles, and not exposing the parent craft to abnormal danger. Reliability and ease of operations, along with payload, are extremely important factors to be considered in the design criteria.

France pioneered SDV technology and adoption, and was the first navy to operate removable dry deck shelters (DDS). It was a major step backwards when they retired the last of the Agosta-class submarines in 2001, and along with them the SDV capability. The SDVs they had operated were a well-kept secret before they were retired. With the future introduction of the Barracuda-class SSN submarines (full operational capacity expected in 2022) the French Navy plans to regain its SDV capability. From the outset, the Barracuda class are designed to carry a DDS behind the sail. The unit will be larger than previous French ones and incorporate direct access into the hull so that divers can access the chamber while it is drained, which is a massive operational advantage. The new SDV for Commando Hubert is the ECA SWUV (Special

Warfare Underwater Vehicle), known in French service as PSM3G (Propulsor Sous-Marins 3rd Generation). At the end of 2019 France's Special Operations Command accepted into service the PSM3G Special Warfare Underwater Vehicle (SWUV). Designed to carry eight combat divers, including a crew of two, it is 8.5m long and carries six men, making it larger and more capable than previous French types. It has a maximum speed of 10kts, and an operating depth of around 100m. Approximately 12 SWUVs will be delivered.

Britain's SBS use a fleet of US-made SDVs and have no recorded incidents; however, an article in the *Morning Star* claimed that the US Navy SEALs have suffered when using the same vehicles. This was exposed by the newspaper in 2019. Under US law, the newspaper obtained 17 years of data from the Pentagon which exposed dozens of training accidents with the vehicles. In fact, between 2001 and 2017 there were 59 incidents identified. It states:

> Four SEALs perished while training with the equipment. Another frogman was left with a permanent partial disability and there were two other 'near drownings'. The most recent deaths were in 2013 – one during a 'planned open ocean swim evolution', and another when a SEAL parachuted into the sea to board the vessel. There was a third death in 2009, when the navigator of a mini-sub died in a training accident, and a fourth fatality in 2008.

The miniature submarines are in fact swimmer delivery vehicles, which have been in use with the SBS and SEALs for a number of years, but during the transition between conventional submarines and the nuclear boats there was no capability to carry the craft to a target area. When nuclear boats could be configured to carry the SDVs they were carried in DDSs as a safe haven for the operators and the vehicles.

The article explains that the US Pentagon announced that Britain had spent almost £70 million purchasing three new mini-subs (in fact SDVs) and added: 'While there is no suggestion that US manufacturers are at fault, the data shows that operating mini-submarines is fraught with risk – and that the British public will not know when its own divers are injured.'

As is clear, being in the elite of the elite diving world is a very dangerous occupation even when training.

Dry deck shelters

The US Navy began to develop the DDS to carry SDVs as far back as the late 1970s, but it was the late 1990s before the first British DDS was designed and built to fit Royal Navy submarines. The first was fitted to HMS *Spartan*, which had to undergo expensive modifications to be able to accommodate

ABOVE
A submarine in dock with a DDS fitted behind the sail. The submarine has to be submerged to allow the SDV to launch and be recovered. (US Navy photo by Chief Journalist Dave Fliese/ Released)

a DDS. It is not just a question of having attachment points on the submarine and then fitting the shelter on, because the access hatch on the shelter has to connect to an access hatch on the submarine to allow people to transfer between the two. The system carrying SDVs was successful, but two years after the transition the boat was decommissioned, leaving Britain without a DDS capability, and that was the case until the Astute class of submarines were brought into service, with the first submarine operational in 2014.

The US DDS differs from the British design and is not interchangeable – it appears that the Astute class of submarines will carry the British DDS which have access hatches built into the submarine's fin, and where it joins to the fin there are panels to help with water flow when submerged. No matter which DDS design is in play, all will have a significant impact on the sub's trim, stability and hydrodynamic performance – where there may be reduced speed and additional noise when the DDS is fitted.

The dry deck shelter is a peripheral object that can be added to a submarine, which in most cases will be modified to accommodate the addition. Within the nice overall shape of the DDS – created for streamlining – are a number of different-sized compression chambers that are joined together to form a single pressure unit. There are hatches on each chamber which allow the divers to move from one to the other, but can be isolated from the others when required. The largest chamber – the hanger to the Americans, or the Special Forces Payload Bay (SFPB) to the British – is where the SDV is stowed.

BELOW
A US Navy submarine with two DDSs fitted, allowing a double SDV capability or an SDV and inflatable boat option. (US Department of Defense, Naval Special Warfare Command)

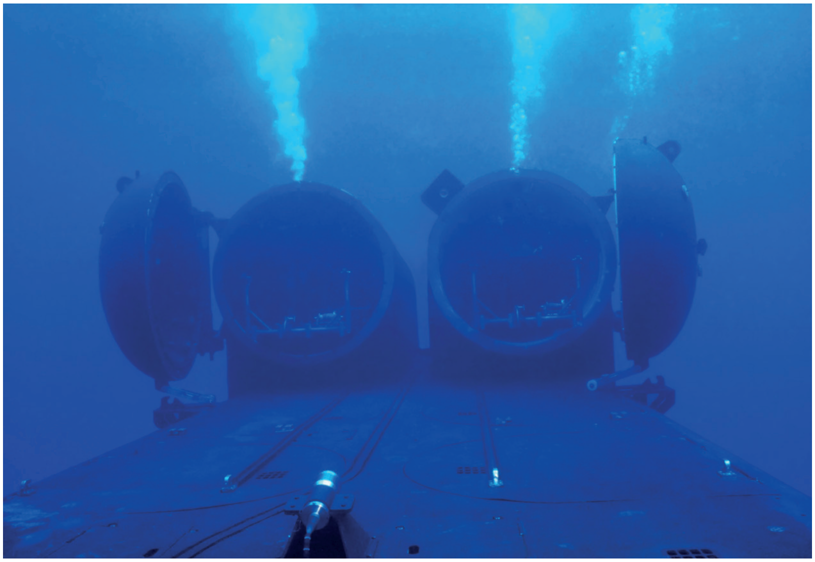
When the DDS is fitted it can accommodate either an SDV or up to 20 divers and their equipment. The US Navy version also has a hyperbaric decompression chamber forward

of the transfer trunk, but the UK version does not appear to have this facility. The Royal Navy Astute class reputedly have a lock-in/lock-out transfer trunk permanently installed inside the sail that allows diver access to and from the submarine while submerged.

At one end of the shelter there is a hatch that allows access to a smaller pressure chamber, and at the other end there is a large door that opens to the sea and allows the SDV to leave and enter. The DDS fitted to the Astute-class boats is a cylindrical pressure chamber approximately 13m long by 3m diameter, and has Royal Navy divers from the Fleet Diving Unit One (FDU1) acting as caisson divers to support SF divers when deployed onboard a DDS-equipped submarine.

US Navy submarines that are fitted with a DDS have two supervisors, one for the DDS and one for the SDV, who work together, supported by a diving medical officer, who only advises those planning the diving operation. The two supervisors have to calculate and manage the dive times and depths. In an ideal world that might be trying to undertake a mission where no diver decompression stops are required, but covert diving is unpredictable so they will have to consider and manage all options. The two supervisors have the ultimate responsibility for the diving operation and will have to determine if it's a 'go' or 'stop'. It is presumed that the British operate a similar system.

If the mission is a 'go', the supervisors will advise the submarine's captain, who will confirm the decision as regards the boat's status, and that there is no external threat to them. On the submarine there is a team of divers, called the hanger crew (US), or caisson crew (UK), who will transfer to the shelter along with the team of SF combat divers, and they are responsible for preparing the SDV for a mission and will secure the inner hatch after passing from the submarine to the hanger.



Two DDSs underwater with their doors open. (Stocktrek Images/Getty Images)

A DDS with its main door open and the support divers, who are using open-circuit breathing apparatus, awaiting the return of the SDV. (US Department of Defense, US Navy)

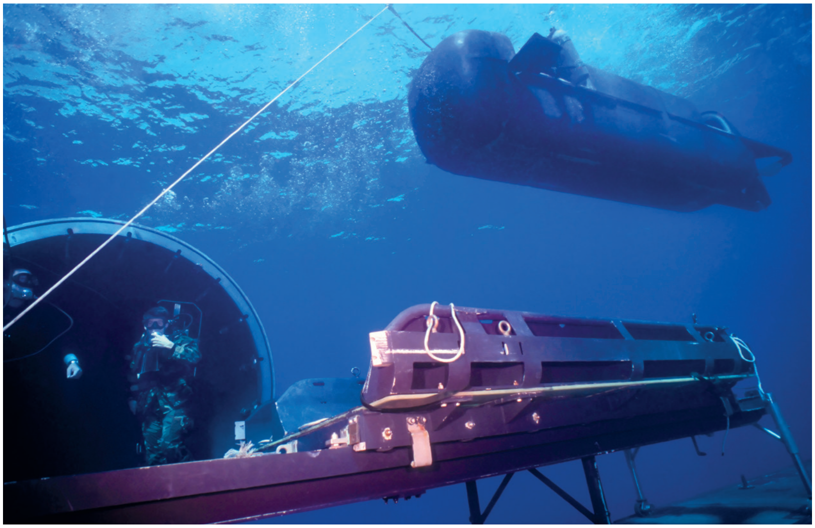
The SDV team of SF divers will prepare for the mission while the hanger remains dry. When the shelter crew have made the SDV ready for the mission, and the SF team is aboard and ready, the hanger is flooded until its internal pressure equalizes with that of the sea outside, then the large main door is opened to the sea – the support divers will breathe air on an open circuit provided by the submarine. The SDV, which is a free-flooding vehicle and sitting on its cradle, is winched out of the hanger until clear of the DDS. When the all-clear signals are given, the SDV supervisor manages the lift off, and sets the depth and compass bearing to commence the operation.

At this point the shelter divers can close the door and transfer back into the submarine through the wet/dry lock, or it might be that the shelter divers remain in the water and await the return of the SDV. However, they must be ready for the SDV's return, and there is no time frame on that because a mission can be aborted at short notice and the SDV will have to be back in the DDS as quickly as possible.

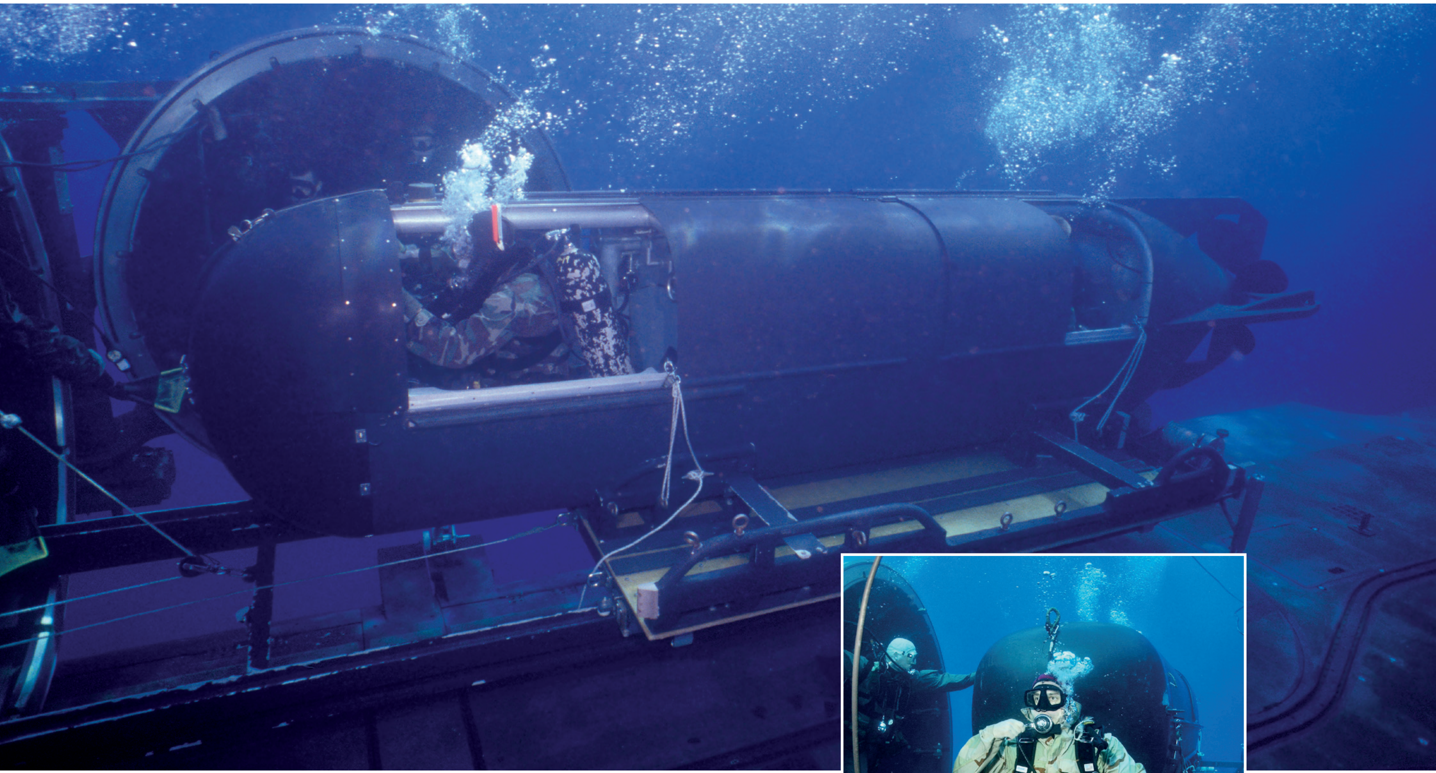
Aboard the SDV, the supervisor on the mission is tasked with monitoring the time, depth and breathing system in use, which is transmitted back to the submarine to allow the DDS supervisor to update the dive plan. The submarine's crew are also kept busy with monitoring any changes in depth, and listening for any hostile activity in the area. During the SDV transit stage the divers can breathe on the vehicles' open-circuit system, leaving a trail of expired air bubbles on the surface, before moving to their individual closed-circuit systems, which do not produce bubbles, as they approach the drop-off point. The SDV remains submerged while the divers depart to undertake their mission, but the supervisor is unable to monitor the depth each diver reaches while away and so that is down to each individual.

A closer view inside a DDS with divers awaiting the return of the SDV. (US Navy photo by Chief Photographer's Mate Andrew McKaskle)

When the mission is completed the divers return to the SDV, and with all divers accounted for, the supervisor will direct the craft to move and rendezvous with the submarine. Communications underwater is not yet reliable, even if possible, but the submarine and SDV carry transponders that will allow each vessel to track the other, and the SDV pilot can locate the mother submarine by active sonar pings. The hanger crew will be in the water, with the door open, awaiting the arrival of the SDV. When it arrives it will be guided onto the cradle, then moved into the hanger, and the main outer door closed and sealed before the water is pumped out. The SDV supervisor and the DDS supervisor can calculate if any decompression time is required. That will all be done within the shelter's or submarine's chambers, allowing the submarine to move away and dive if required. All of the divers then transfer through into the submarine – mission accomplished.



Members of the hanger crew will attach lines to the vehicle as part of the process for the recovery to the DDS. (Stocktrek Images/Getty Images)



In a 2020 briefing, SOCOM and the Naval Special Warfare Command (NAVSPECWARCOM) had six DDSs undergoing sustainment, safety certifications and maintenance to prolong their service lives, with work being done to modernize one shelter by incorporating field changes. According to the brief, the DDS modifications include: a remotely operated hanger outer door; extending the DDS's length by 1.28m; increased capacity payload launch and recovery system; reduced operator fatigue and risk to the host submarine; and remote control from the host submarine.

These shelters are tailored for piggyback attachment to the back of Virginia-class nuclear-powered attack submarines (SSN), with other DDSs tailored for Ohio-class nuclear-powered guided missile submarines (SSGNs), and the predicted retirement of all six DDSs is between 2042, through to 2051. The US Navy can mount and use DDSs on the backs of converted Trident Ballistic Ohio-class SSGNs for land attack and special forces missions, for as long as the ageing SSGNs are in service.

A DDS can be a dangerous place, in the same way that commercial saturation diving can be, but there are procedures in place to mitigate the risk, and special forces diving as a whole is a dangerous business.

OPPOSITE TOP
A side view of an SDV on its docking sled at the entrance to the DDS, ready to be pulled inside. (Michael Wood/Stocktrek Images/Getty Images)

OPPOSITE INSET
A member of the hanger crew guides an SDV sitting on its sled into the DDS. (US Navy photo by Chief Photographer's Mate Andrew McKaskle/Released)

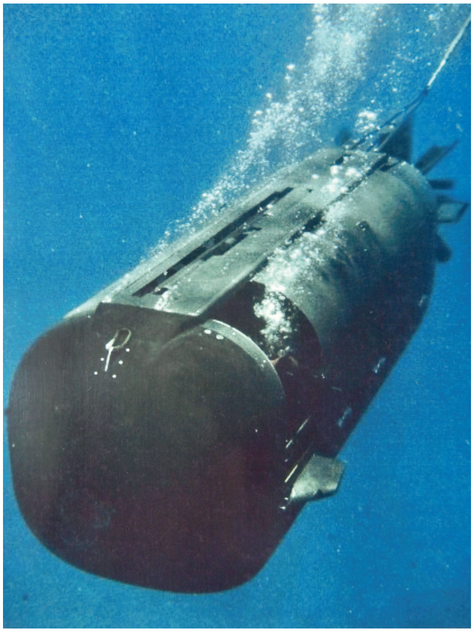
The Mark 8 SDV

The Mark 8 SDV is a wet vehicle, designed to carry six divers and their equipment. As with the other wet vehicles the divers are exposed to the water environment, and use an onboard breathing system when in transit, switching over to their individual closed-circuit sets when operations require it. The vehicle is driven by an electric motor, powered by rechargeable batteries, the latter defining the vehicle's endurance. The craft carries numerous systems to support navigation, obstacle-avoidance, and a system for rendezvousing with the parent submarine or surface craft. Apart from the US Navy, the Royal Navy has three MK 8-Mod 1 SDVs which are used by the SBS, but they are outdated – and if they want to be at the forefront of special forces underwater operations then they need the MK 11 SDV. MK 8 SDVs were used to accomplish classified mine reconnaissance and demolition missions during Operation *Desert Storm*. During Operation *Iraqi Freedom* they were used to secure offshore gas and oil terminals. That said, all SDV operations have been, and continue to remain, substantially classified for both the US Navy and the Royal Navy (SBS).

The Mark 11 SDV

The Defence Security Cooperation Agency revealed in 2018 that the British government has purchased three MK 11 Shallow Water Combat Submersibles (SWCSs). Also included are spares; handling equipment; test equipment;

OPPOSITE BOTTOM
A member of the hanger diver crew is alongside the SDV pilot as the vehicle enters the DDS. (Stocktrek Images/Getty Images)



operator manuals and technical documentation; US government and contractor engineering, training, technical, and logistical support services; and other related elements of logistics and programme support. The total estimated programme cost is about $90 million. This will support foreign policy and national security objectives of the United States by improving the security of a NATO ally which has been, and continues to be, an important partner on critical foreign policy and defence issues.

The Mark 11 has a length of 12m, a height of 2.4m, and has a crew of two, plus six divers. The life support system comprises an onboard open-circuit air system that provides eight operators with four hours of air, with an added reserve. The seating in-craft is moulded seats with advanced shock-absorbing systems designed to provide a comfortable ride even at high surface speed, and a rail attachment system enables quick and simple re-configuration of seating to suit the mission needs.

The Mark 11 SDV carries its crew and combat divers inside the vehicle but exposed to the water. It is carried in a DDS, and when launched while submerged, it departs the mother submarine to undertake its mission. (US Department of Defense, Naval Special Warfare Command)

As is expected with a modern SDV, it is easily transportable and fits in a standard ISO shipping container. The vehicle is designed to operate independent of strategic assets and particularly from vessels and ports of opportunity. Able to deliver a team of special forces divers up to 250nm on the surface, and transitioning to the sub-surface mode 12nm from the target area, it can deliver the team close to their operating area using individual rebreathers for the final infiltration to target.

The upgraded SEAL Delivery Vehicle is a wet, free-flooding submersible that is in service, and the United States Special Operations Command (SOCOM) calls them the Shallow Water Combat Submersible (SWCS). The vehicles have a sensor mast with an electro-optical periscope, passive sonar, ultra-quiet propulsion motors and inertial navigation systems, avoiding the need to surface to receive GPS signals. The hull is made from aluminium. The SWCS also has more advanced computer systems and better navigation, and there is both wireless and wired communication between crew members, sonar detectors and sonar-assisted automatic docking. The computer and sensor mast are designed as modular systems so that individual sensors or systems can be exchanged as required for an individual mission, and upgraded when required. The SWCS carries a total of six divers: a pilot; a co-pilot/navigator; and four other divers. It can be deployed from surface ships and from a DDS on a submarine, with the latter being the preferred option for covert operations.

Both the MK 8 and MK 11 require the divers to use drysuits or wetsuits, and underwater breathing apparatus, as the crew and divers are exposed to a sometimes long underwater journey. That is the nature of the SDV and poses a challenge for the operators to develop thermal protections through both

heating and cooling of the divers' dive suits. There is also a need to develop an improved underwater communications system between divers and crew, and with the other divers.

The concept is that the SWCS will be able to access areas that the US Dry Combat Submersible (DCS) cannot. It will be deployable from submarines, a capability that the DCS lacks due to its size and weight. However, the SWCS's larger dimensions required the DDSs to be enlarged to accommodate it, which means lengthening the DDS by 1.3m.

Subskimmer

In the 1980s a unique combined surface and underwater craft emerged from the workshops of Submarine Products, in the form of the British-designed and built Subskimmer. The concept has survived the test of time and remains an operational unit in 2022 and beyond. The design is based on a proven military rigid hull inflatable, powered at the time by a single powerful outboard engine. It can be converted, in about a minute, to a self-contained, submerged swimmer delivery vehicle, with electric thrusters producing up to 2.5 knots underwater, and with an operational duration of up to six hours from its own battery power in the original version.

The main hull is rigid, with inflatable tubes, as in a conventional surface craft, but the outboard engine is encased in a pressurized waterproof housing, with an exhaust system which is closed prior to submerging. The requirement for a large engine on such a small craft is because of the all-up weight carried, in the form of batteries, air cylinders, pump equipment, the underwater propulsion unit, and of course the operatives.

Transformation from surface craft to swimmer delivery vehicle is via a powerful suction pump housed in the centre of the craft, which sucks the air out of the boat's side tubes, collapsing them, and allowing the boat to become awash. The final de-ballasting is done through the pump housing. The pilot sits behind the swivelling motor tube in the bow and, once awash, can start the electric propulsion units which enable steering in either direction, or up and down, by simple hands-on control. The instruments are housed in the cross tube in front of the pilot, including: a log; depth gauge; speedometer; timer; compass; echo sounder; amp and voltmeters; and the power switches. The 1kw thruster units pull the craft through the water at a speed determined by visibility, combat conditions, and possible obstructions, the power for the thrusters coming from two separate 5kw-per-hour banks of batteries.

The 1980s version of the Subskimmer was able to carry four men with limited equipment for a range of some 160 kilometres, at a speed of 25 knots, with a final underwater operational capability of 10km at 2.5 knots. If a heavy stores load is carried the crew is reduced to two, and the load could be in the form of additional fuel pods, which will extend the range considerably.

RIGHT
A Subskimmer at speed, clearly showing the main elements of the craft. (Marine Specialized Technology Group)

BELOW
In the process of purging the tubes of air to allow the craft to submerge for the underwater part of the covert operation. (Marine Specialized Technology Group)

All members of the crew would be dressed for underwater swimming, and would use closed-circuit underwater breathing sets when on covert operations.

The possibilities of this craft were, and still are, immense – for countries without a large submarine delivery system it opens new doors to enhance a country's underwater operational capabilities. The early version had a length of 5m and an unladen weight of 800kg, so it was well suited to being carried by a fast patrol boat or fishing boat for surface delivery, from where it could speed away towards its target. Palletized in the same manner as the inflatable raiding craft, it could be parachuted into the operational area and joined in the water by parachute-delivered divers. In enhanced helicopter operations they would be an ideal transit platform for the craft and the crew. With Subskimmer being a submarine as well as a surface craft, it could be carried by a large submarine in a DDS or a pod that is secured to the submarine casing. At the drop-off area, the divers would join the craft while submerged, and then fly clear of the submarine and inflate the tubes, to ascend to the surface before speeding towards the target area.

In 2021 the company Marine Specialized Technology Group stated that there are more than 55 Subskimmers in service. Now in its fifth generation, it is a firm favourite, particularly with countries beyond European and NATO operators, for whom the Subskimmer is easy to operate and maintain. The Subskimmer 680, described as a surface-planing wet submersible, has a length of 6.8m, a beam of 2.3m and a weight of 2200kg. It has a capacity for up to six persons, with a range on the surface of 75nm, and range while submerged of 4nm. It has a speed of between 25 and 30 knots on the surface, depending on loading, and a speed submerged of 1.5 to 2 knots. The payload of the craft, including fuel and crew, is 900kg.

The instrument and control console is located at the bow of the craft. The forward thruster units for underwater propulsion are located either side of the console. The equipment fit would be to the customer's requirements. (Marine Specialized Technology Group)

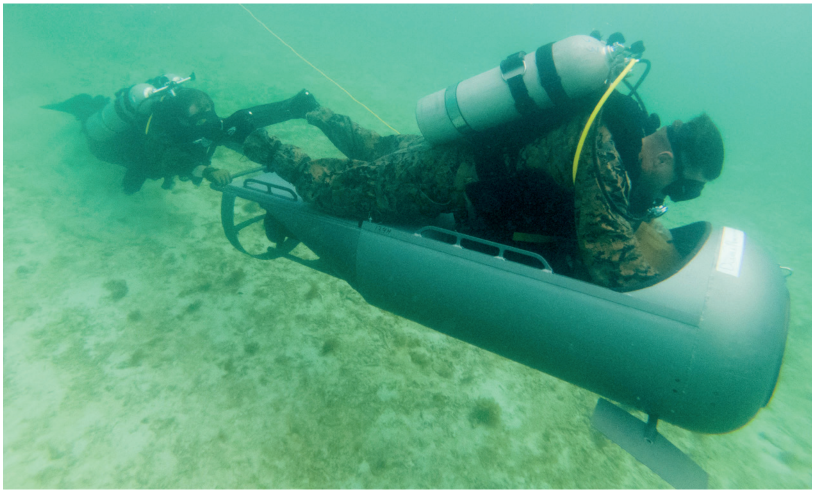
This all means that from its conception in the 1980s, Subskimmer still serves as an essential maritime stealth tool in global special operation forces. While visually quite similar to the original, under the skin it employs much newer technology, and the very latest in combat diver navigation and situational awareness systems. The photos show the instrument and control console located at the bow of the craft, with the forward thruster units for underwater propulsion located either side of the console, and two thrusters at the stern. The instrument fit would be to the customer's requirements and availability, so as to provide the crew with relevant information.

This combination of craft and diving system allows swimmers to proceed to the target on the surface at a speed dictated by combat circumstances, and when necessary transform the vehicle into a swimmer delivery vehicle, allowing the final phase to be underwater. Because of Subskimmer's flexibility, it can be used in all environments, from northern Norway to the Middle East and Africa, and in quantity for large amphibious operations, or in pairs for more covert reconnaissance missions. Their use in ship and harbour attacks enhances the swimmers' survivability and success ratio.

Withdrawal from the combat area could be undertaken submerged, then awash, and finally on the surface, at slow speed initially, then at increased speed once clear of the enemy's observation posts. The rendezvous with the parent craft, whether submarine, surface vessel or helicopter, would find the crew less fatigued than with some more conventional methods of transportation.

STIDD Diver Propulsion Device

The STIDD Diver Propulsion Device (DPD) is claimed to be the most widely used military grade underwater mobility platform in the world. With hundreds of units in operation by maritime forces, the DPD offers combat swimmers an underwater mobility system which is proven, fast, robust and reliable.



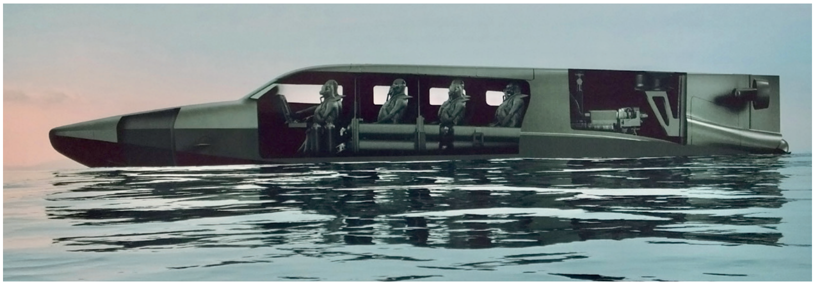
A US Marine Recon diver on a diver propulsion craft with a buddy in tow. (US Marine Corps photo by Lance Cpl Jackson Dukes)

The DPD enables divers to travel farther and faster with more payload than previously possible with any other diver propulsion device, and the addition of a second high-capacity lithium-ion battery can effectively double the range.

The DPD with Dual Thruster (DPD-XT) maintains all of the Standard DPD's exterior dimensions and certifications, while the manufacturer states that it is 33 per cent faster than the standard DPD, has two independently redundant propulsion systems for improved mission safety, twin high-efficiency, low-noise direct-drive DC thruster motors with high-bollard-thrust Kort nozzles, two batteries and additional towing capacity – easily towing three or four divers with a full load.

VICTA

VICTA combines the characteristics of a fast surface craft with those of a submersible. It moves quickly and seamlessly from surface to sub-surface, and this transition, along with its performance in both domains, is enabled by an innovative fly-by-wire control system. The speed on the surface is 40kts, with a 250nm range, and with four hours' endurance underwater it can carry two crew and six divers for 25nm.



An artist's drawing of a VICTA on the surface. (Subsea Craft)

The carbon fibre and Diab core hull gives an efficient strength–weight ratio, which can withstand the wide range of surface and sub-surface loads that are dictated by the mission profiles. It is powered on the surface by a customized diesel engine outputting 725bhp to water jets. Control of the craft is through a purpose-built steering column, giving the pilot a common interface for both surface and sub-surface running. When submerged, a pair of 20kW marine propulsion electric thrusters provide forward propulsion at speeds of up to 8kts, and the craft is 'flown', with roll and pitch controlled through forward and aft hydroplanes. Four thrusters are mounted vertically for accurate slow-speed depth control.

An artist's drawing of divers in a VICTA. (Subsea Craft)

James Fisher Defence

The James Fisher Defence (JFD) Seal Pod range of swimmer delivery vehicles has been produced to support the insertion and extraction of special forces and equipment. They are surface or sub-surface craft, each optimized for a particular deployment method or mission profile. The vehicles can be adapted to include specialist maritime operations, mine countermeasures, counterterrorism, counter-narcotics, counter-piracy, and maritime protection operations. JFD states that:

The Torpedo Seal is in the front with the Shadow Seal in the centre and the Carrier Seal at the back. The view shows the relative sizes in the range of craft. (JFD Marine)

The vehicles combine the Swedish commitment to safety-led design and the ship-building heritage of the Clyde; all underpinned by a unique operational pedigree with operator input at all stages of the process. Development, testing and trials of JFD SDVs have taken place in the Stockholm archipelago, the Baltic Sea, Portland Harbour and the waters off the west coast of Scotland.

The JFD Carrier Seal

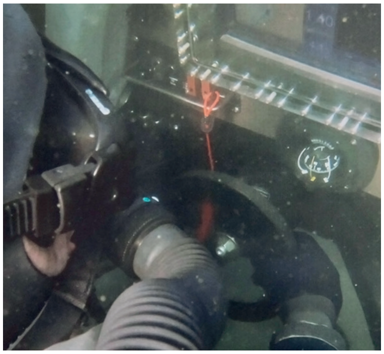
The JFD Carrier Seal is an eight-man swimmer delivery vehicle designed for the covert insertion and extraction of combat diver units, and can operate in three modes: surface, semi-submerged and submerged. Transiting at a speed of up to 30kts on the surface, it then goes to submerged mode for a covert final approach.

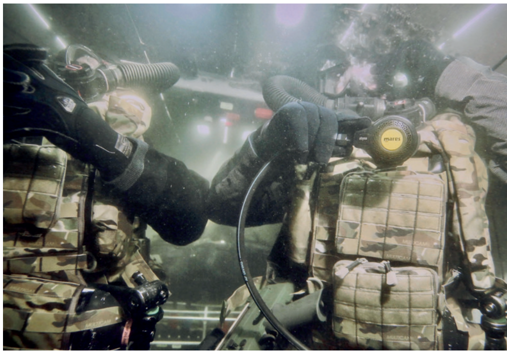
The SDV is fitted with onboard sensors and navigation systems that combine to provide safe transit and accurate positioning, both day and night, above or below the surface of the water, regardless of environmental conditions.

BELOW
A Carrier Seal provides a high-speed long range over-the-horizon Tactical Diver insertion capability. (JFD Marine)

RIGHT
The supervisor/pilot control position inside the Carrier Seal. That diver is responsible for the delivery and recovery of the dive team being transported to the operational area. (JFD Marine)

FAR RIGHT
Divers inside the Carrier Seal being transported to the operational area before they exit the craft and swim to the target. (JFD Marine)





A Carrier Seal riding low on the surface and using a machine gun to support onshore operations. (JFD Marine)

In addition to divers and their personal equipment, mission specific equipment can be accommodated, dependent on weight and size. For operations requiring extended range, the craft can be equipped with additional battery packs. It can also be fitted with a variety of weapon systems which will transform the vehicle into a surface combat craft to attack a coastal target and support diver operations.

The JFD Sub Seal

The JFD Sub Seal vehicle is primarily launched from a Dry Deck Shelter while fully submerged, at depths up to 30m. The vehicles can also be deployed by surface craft or rotary-wing aircraft, and once launched they remain submerged for the entire mission. Eight divers can be carried, two of which would generally be the pilots of the craft, leaving six to be deployed to a mission target. Although designed to remain underwater the vehicle can break the surface for communication or reconnaissance purposes. Power is provided by lithium polymer batteries and a vectored-thruster arrangement, affording sprint speeds greater than 7kts, and a range of 80km.

The Shadow Seal is able to operate on the surface and underwater. It can carry four combat divers plus some additional equipment. (JFD Marine)

The JFD Torpedo Seal

The JFD Torpedo Seal SDV is the smallest of the craft, which enables two divers with combat gear and mission essential equipment to be transported fully submerged, over a range of 16km. The size and weight of the craft allows it to be transported using the multi-purpose (torpedo) tubes being fitted into future submarines, or beneath the outer casing of the submarine. It can also be delivered by fixed-wing aircraft or helicopter, along with its divers. The craft is controlled by a single pilot, and carries one other diver and equipment.

The JFD Shadow Seal

The acquisition of Ortega Submersibles, who are based in the Netherlands, added the JFD Shadow Seal SDV to the range of craft. It can transport four divers on the surface and fully submerged. It is powered by two high-power electric motors, and is equipped with closed-loop trimming tanks, bow and trim thruster, and an underwater navigation system. It is also equipped with onboard suit heating, which assists with diver endurance.

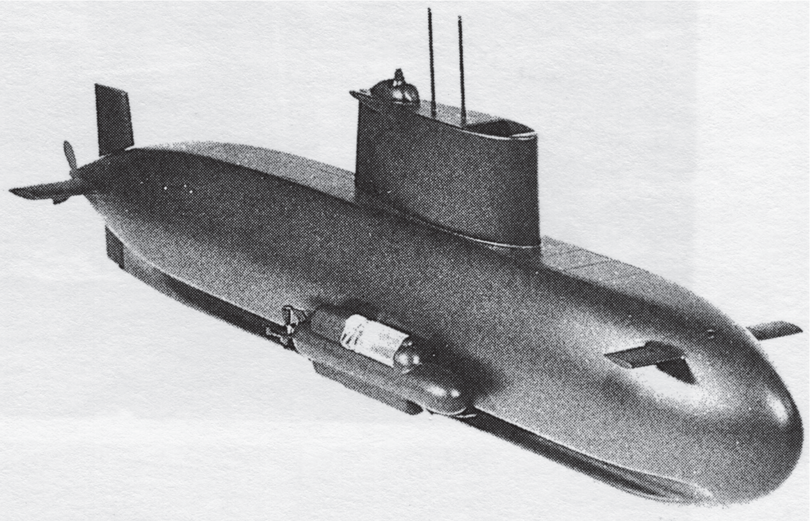
It is evident that Swimmer Delivery Vehicles are a serious option for navies across the globe, and while few might be able to accommodate the larger vehicles, there is a growing number of smaller and less costly versions being developed and purchased. In real terms it means an increased threat level from these craft and the divers who travel on or in them, as they gain more access to ports, harbours or targets close to a seaboard. As they see what special forces can do using these craft, rogue nations, terrorists, pirates and drug runners will also adopt them as they up their game.

CHAPTER THIRTEEN

MINI-SUBMARINES

What is the difference between a mini-submarine and a swimmer delivery vehicle? For the purposes of this book, the mini-submarine is a smaller version of a large submarine, where the crew and special forces divers are in a dry environment until they need to exit. They have a built-in chamber that allows them to exit and return to the submarine while it remains underwater. Because of its small size and low draft the mini-sub can get closer to a target, and is not so easily identified as the full-size submarine. It also provides a safe refuge for the special forces operators when transiting to and from the target area, compared to the swimmer delivery vehicle, where the diver is continually exposed to the water (see Chapter 12).

Mini-submarines played an important role with the Royal Navy undertaking covert operations in World War II, but they were not alone as the Germans, Soviets and Japanese had also created their own versions which operated to varying degrees of success. The Japanese used five mini-subs to attack Pearl Harbor; they carried two torpedoes, but did not deploy divers. The Germans were late getting into production and there was no notable mini-sub activity. The Soviets concentrated on making their tanks waterproof so their mini-subs had tracks for propulsion.



The 1980s Vickers Piranha concept, which was never produced. (Author's Collection)

Following the war, the British mini-submarine eventually disappeared from the Navy's inventory as it was assumed it was no longer required, while it seems that the Soviets captured valuable data and personnel when they overran the east of Germany at the end of the war. They then continued to evolve the small vessels during the Cold War, and although the targets of their attention never managed to sink or capture one, there was evidence of their existence.

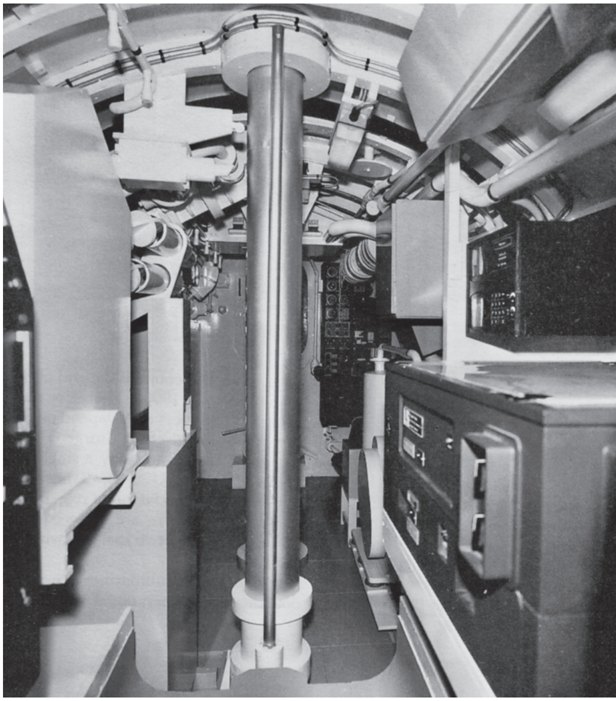
During the Cold War era the Soviets continued to make use of the small craft to undertake covert operations with the use of a large submarine as the mothership, but elsewhere the major nations generally used conventional submarines to carry their covert operators to a location where they could deploy in inflatable boats or canoes to reach a target. That meant the submarine was on the surface, exposed to enemy activity. Divers could lock out of and back into the submarine while it remained submerged but they could be left with a long swim to a target.

Design concepts

In the 1980s I attended a defence equipment exhibition and discovered a new project for a mini-submarine, named the Piranha. The idea was that rather than commit a large submarine to a covert operations role, when it could be more usefully employed in its patrol role of hunter killer, a small specialized submarine could be a more suitable alternative. The Piranha was designed specifically for the role of covert missions, and developed by the UK shipbuilders Vickers, who constructed a mock-up.

It was designed to deliver a team of ten special forces troops to a target area, where they could either disembark while the submarine was on the surface or they could be locked out using the built-in diver lock, two divers at a time. A pair of two-man SDVs could be carried, one either side of the hull. If an operation was a seaborne diver raid against a harbour, the SDVs could be replaced by six high-capacity bottom-laid mines, which the Piranha could lay while the divers carried a limpet mine raid. The relatively small length of the vessel, at 26.6m, was designed to make it ideal for its role in special operations as it would be able to penetrate into shallower water, with a low risk of detection. Even when on the surface, its fin would be small when compared with its larger sisters but nevertheless it could give away its location.

The vessel's transit range was planned to be 1,800 nautical miles on continuous snort, using a device which rises above the surface to draw in air, allowing the submarine to operate while submerged and providing an operational radius of 800nm, or a range of 70nm at 4 knots when completely submerged. Stores carried on board would allow the seven-man crew and ten special forces troops to remain on patrol for 12 days. Piranha was to carry a range of equipment to aid operations, including: passive sonar, noise-



The control room for the new concept Piranha mini-sub. (Author's Collection)

monitoring sonar, a radar-warning receiver, and both attack and search periscopes. These would be combined with transceivers and antennae to communicate in the HF and UHF bands. Looking back, the concept was appealing but it had a limited role capability that could not be undertaken by existing larger submarines. It had no attack system, such as torpedoes, and for just a special forces role its cost against operational value saw the project fade into the history books, even for those countries with small navies.

Also in the 1980s, the advanced concept Deep-Discharge Lead-Acid Battery-powered vehicle was proposed with an overall length of 13m and a beam of 1.8m. Its displacement was 27 tons, and the power source would produce a cruise speed of 10 knots. The advantages of this concept were its low cost, the least technical risk, a low acoustic signature, reduced design complications, and the fact that it would utilize established technology. On the disadvantage side, it would have a reduced operational capability, a large hull, and although it could carry the same payload at the same speed, it only had an operational range of 100nm.

The alternative was the Closed-Cycle Energy Source (CCES) powered craft, which had an overall length of 10.6m, a beam of 1.8m and a displacement of 17 tons, with the ability to cruise at 10 knots, and an operational range of 300nm. The principal advantages would be the very high energy-density unit, which was the smallest and lightest of the proposed designs and able to operate within the desired range and depth criteria, carrying the required payload. On the other hand, the disadvantages were that although the engine was established technology, it was not in production, and there were technical risks; the acoustic signature was also greater.

A general description of the CCES unit was that it would be a propane-fuelled, rotary, internal combustion engine using liquid oxygen as an oxidizer and helium as a dilutant. The CCES concept would also use a mechanical scrubber for carbon dioxide removal, in lieu of the bulky chemical absorbent beds. The basic problems at the time were that a suitable production unit had yet to be assembled, and the use of the mechanical scrubbing unit for this application had not been proven. The internal combustion engine was noisier than the battery-powered systems and would have needed to be damped. The US submersible designer and builder Perry Inc were confident that they could overcome the problems and would be able to present the military with a viable SDV that could deliver combat divers to their operational target. While an interesting project, it appears that the vessel did not materialize, probably for the reason of cost against the research and operational value of such a vessel.

But the mini-submarine concept did not go away, and over the years military maritime equipment providers took to the drawing boards with designers and engineers looking 'outside the box' to develop the ultimate covert underwater vehicles for combat diver operations. The land-based conflicts in Iraq and Afghanistan absorbed the militaries, so special forces' need for mini-subs was far from the minds in the mountains and deserts. In more recent years the nature of warfare has evolved, with very real and actual threats from many more quarters, with the outcome that dry mini-submarine concepts are being explored and revived.

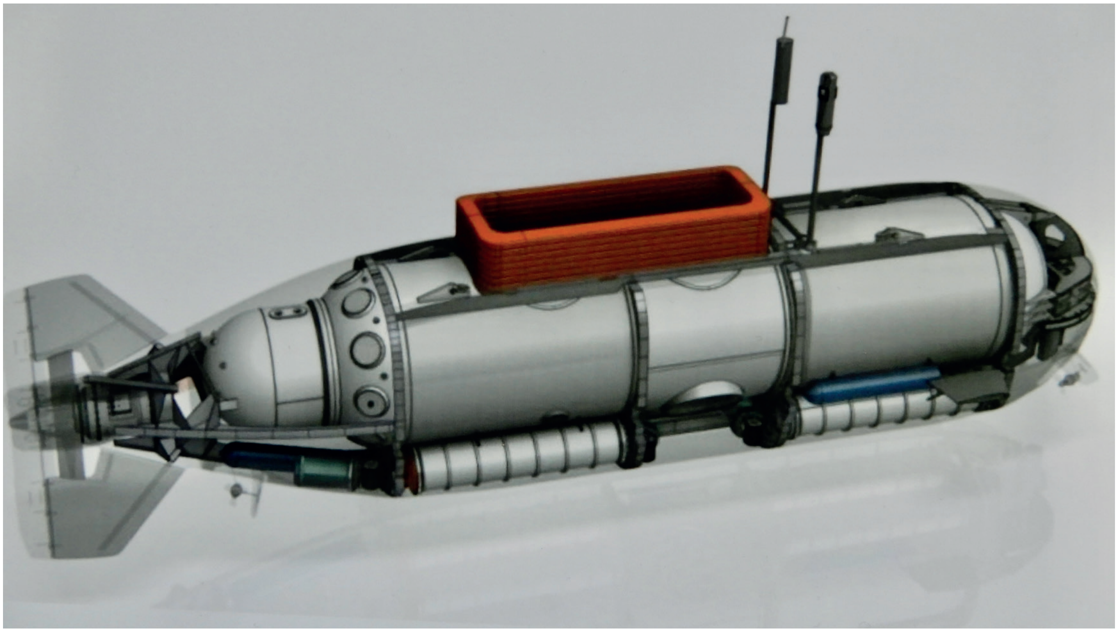
S361 swimmer/diver lock-out submersible

The UK is fortunate to be a world leader in mini-submarine development. The company MSubs Ltd (Marlin Submarines Ltd) has been designing and building high-quality manned submarines since 1986. More recently, MSubs has designed and built specialized submersibles – supporting diver lock-out and long-endurance operations – as both scientific research vessels and military vessels.

The S361 swimmer/diver lock-out submersible is capable of operating independently or deployed from a host ship. Designed to answer the need for a long-range submersible, S361 incorporates many design innovations that improve overall capability and enhance vehicle and swimmers' operational effectiveness. The submersible has three watertight sections: a forward section which is the transport compartment that houses up to eight swimmers or other payloads; an amidships swimmer lock-in/lock-out compartment; and an aft compartment that serves as the pilot/navigator operating station with a mature Command System.

The S361 is 12m long, with a beam and height of 2.4m. It does not have a sail to expose it in shallow water; however, it is not designed to travel on the surface, but unseen below the surface. The submersible weighs 28 tonnes. It has a crew of two – a pilot and a co-pilot/navigator – and carries eight fully equipped combat divers. The internal structure comprises three dry pressure chambers, with the bow chamber accommodating the divers while they are on board. Amidships is the diver lock-in/out chamber with an exit to the open sea. The aft chamber is the control centre where the pilot and co-pilot operate the sub and they have a hatch in the top to allow access and egress. All of the chambers are interlocked and through-hatches can allow access from bow to stern, but each chamber can be sealed from the others.

The S361 shows the concertina skirt that can be raised to provide protection when on the surface and the top hatches are open. It also shows the side access hatch in the mid-section to allow combat divers to exit and enter. (MSubs)



This cutaway illustration of the S361 shows the concertina skirt that can be raised to provide protection when on the surface and the top hatches are open. It also shows the side access hatch in the mid-section between the battery pods. (MSubs)

The S361 can be fitted with the latest navigational systems, including an inertial navigation system and doppler velocity log. There would also be sonar and fathometer options, along with other sensors which can be added depending on mission requirements. The communications equipment includes an underwater telephone and UHF radio. As to be expected, the operating capabilities of the craft remain classified but it is thought to have a maximum depth rating of 100m and a lock-in/out maximum depth of 30m. Its batteries give it a range of some 60nm at a speed of 5 knots (9.3km/h), although its maximum speed is not readily available.

An Amphibious Landing Platform might be able to be adapted to launch and recover the S361 in the stern dock area and it could also be deployed using a vessel with a 'moon pool', which is an opening in the bottom of the hull. Bearing in mind that the sub has a length of 12m and a beam of 2.4m, that would be a big hole in the bottom of a ship. It would also require a special handling frame, such as those used for a saturation diving bell on a diving support vessel, to compensate for the surge of water generated by the ship's movement. The alternative options are for the sub to be launched by a crane, either the beam or stern. A key factor is that a sub can be carried in a standard 40 foot (12m) shipping container which means that it can be transported around the world in some secrecy to be loaded onto a mothership without raising curiosity.

In operations the divers travel in a dry compartment until within swimming distance of the target, which is an advantage in colder waters, and they do not need to use breathing apparatus until required to deploy and so are able to

communicate with each other, albeit in cramped conditions. Once within swimming distance of the objective, the operatives put on their breathing sets and enter the lock-out chamber, which is also dry and at atmospheric pressure. With the divers in the chamber the flooding begins to equalize the internal pressure to the depth of the water outside. When equalized the external hatch is opened – which is set to one side and not on the bottom, as it would restrict the divers' access if the sub sat on the seabed. Upon the divers' return they re-enter the sub, seal the hatch and blow the water out until the chamber is equal to the other chambers, allowing the divers to gain access to their transport chamber. There is no doubt that conditions – especially for the divers – are tight, but there is no comparison to an SDV where they would be exposed to the water for the whole mission. The two-man crew can remain in dry conditions throughout the operation unless they are required for the mission, in which case they can leave the sub parked on the seabed.

The S303 submersible

MSubs submersibles have a number of options with regard to length, beam, weight and carrying capacity while having a diver lock-in/out facility. The S303 submersible is the smallest mini-sub and is the latest successor in the light diver lock-out class of submersibles, which provides an easily transportable submersible that can fit in a submarine's dry deck shelter located on the deck of small diesel-electric submarines, as well as on smaller surface ships with suitable lifting equipment. The S303 has a length of 7m, a beam of 2m with a complement of two pilots and six divers and can operate for 24 hours with a 96-hour reserve.

The S401 diver lock-out mini-submarine

At the other end of the scale the S401 diver lock-out mini-submarine is the largest craft, providing for an increased payload, longer range and extended endurance. Flexibility in the design allows for the trade-off of additional passengers or payload with more battery pods, allowing clients to optimize the performance characteristics to their particular needs. The S401 is the culmination of all the lessons learned in prior electric, diesel-electric and diver lock-out submersibles. At a length of 16m, beam of 2.5m, height of 3.2m and a weight of 40 tonnes it operates on batteries but has a possible option of using fuel-cells. Another possible option is diesel-electric, which according to the organization Professional Mariner:

> because of its versatility and redundancy, diesel-electric is adaptable to vessels of almost all sizes. In diesel-electric systems, multiple diesel engines, each driving an electric generator, produce the electric power

that energizes the electric motors connected to the propellers as well as other electrical loads on the ship. Depending on electrical demand, not all diesel generators have to be operating at all times.

LR5 rescue mini-sub

The LR5 Australian Submarine Escape & Rescue System, which is under contract with James Fisher Defence to provide the vessel and the operating team of pilots, engineers and technicians to maintain and upgrade the system, weighs in at 21.5 tonnes, and normally operates with three submersible crew members: the pilot; a co-pilot; and the systems operator. The LR5 is designed to accept up to 16 submarine survivors at a time and transfer them to a surface mothership or to a mother submarine. The LR5 could make up to eight trips to the distressed submarine (a rescue capability of 120 personnel) before needing to recharge the battery power supply.

The rescue submersible is launched by crane over the stern of the mothership and descends to the stricken submarine. The deployment as well as the recovery to the deck is very weather dependent. The pilot is guided to the escape hatch by the transponders, and moves the craft onto the submarine's casing, aligning it with the escape hatch. To mate the two hatches, the pilot uses video cameras installed underneath the submersible and inside the skirt. Apart from aiding the pilot, the rescue can be recorded for future evaluation. Once the submersible is in position the pilot thrusts the vehicle down so that the two sealing faces mate, and drains the water inside the skirt into the submarine's bilges by

BELOW LEFT
The LR5 rescue mini-sub launches over the stern using a specially designed frame and winch, the latter able to compensate for the launch vessel's movement in the sea. It can happen that the mini-sub is in the water and then out again due to wave movement – only to slam back into the sea as the wave passes and the stern drops. (Australian Department of Defence)

BELOW
This shows the rescue mini-sub being launched or recovered over the stern. (Australian Department of Defence)

operating a suction pump. As the pressure reduces, the two joining faces are pushed together to form a seal.

When the pressure has equalized, the hatches of the stricken submarine and the rescue submersible can be opened. The life support and medical equipment are the first items to be transferred. When the first group have moved into the rescue craft all hatches are closed and sealed and the skirt is then flooded to equalize with the surrounding water pressure. The ballast weights can be released which then free the rescue vehicle and allow it to ascend to the surface and be recovered by the surface support vessel. Once on board the rescued personnel disembark, leaving the rescue craft's crew and support team to prepare for the next dive. These dive sequences continue until all of the stricken submarine's crew are rescued.

According to naval-technology.com, the Australian Department of Defence (DOD) has terminated a contract with Phoenix International Australia for the supply of a new deployable submarine rescue system (SRS). The SRS, which would have been one of only four air-transportable systems in the world, was intended to support the capability requirements of the Royal Australian Navy (RAN). It was being procured for both the Collins-class submarine force and the Attack-class submarines, and could be quickly deployed in support of a distressed submarine anywhere in Australia's area of operation. Under its current contract with James Fisher Defence Australia, the RAN holds a suitable SRS that can be sustained into the late 2020s for the Collins-class fleet. In the meantime, the Australian government will explore the feasibility of acquiring a replacement system.

Other mini-submarines

Without doubt many nations are seeking to upgrade their existing mini-subs or are procuring them to add to their existing fleets. They seek new designs with better capability for both defence and strike options, and so the role of the special forces diver is evolving.

It is known that Russia has mini-submarines, as do Turkey, Pakistan, Indonesia and South Korea – who might have imported vessels for their navies, but are currently developing their own series of mini-subs. Pakistan uses the Cosmos MG110 which can carry eight special forces divers and two SDVs for missions involving the Special Service Group Navy (SSGN). The problem is they are ageing, having entered service in the 1980s, but it does indicate that the country has a long history of covert underwater operations using mini-submarines, so it can be expected that Pakistan will retain SF operations capability, which would require deploying divers and SDVs.

There were talks in 2016 between the Pakistan Navy and the Turkish defence vendor Savunma Teknolojileri Mühendislik ve Ticaret A.Ş. (STM) for the joint development of a mini-submarine to supplant the Pakistan Navy's

ageing mini-submarines. A joint venture may already have equipped Pakistan and Turkey with an upgraded mini-sub capable of carrying covert diver operations. At an International Defence Industry Fair (IDEF) the Turkish defence firm STM unveiled its design proposal for the x-TS1700 mini-sub. The vessel has a displacement of 1,740 tonnes, a length of 60.14m, and a diameter of 6.5m, and can accommodate a crew of 25 (as well as six special forces operatives). The submarine has eight torpedo tubes for heavyweight torpedoes and anti-ship missiles. The company proposes a diving depth of 300+ m, top speed of 20+ kts, and endurance of 90 days (with air-independent propulsion). The proposal is that the craft will take on a wide range of roles including, among others: land attack; intelligence; surveillance and reconnaissance (ISR); and special operations.

Indonesian shipbuilder PT Palindo Marine showcased its mini-submarine design, named Kapal Selam Mini, at Indo Defence 2016. The 22m submarine is intended for special forces operations, carrying a crew of five alongside seven special forces operatives. The submarine will be able to remain submerged without snorkelling for up to three days and dive to up to 150 metres. The design is a very lightweight submarine that carries no armaments and so would be used for special forces missions.

It is accepted that Russia has deployed mini-submarines for military missions, so mini-sub technology in Russia is not new, and probably the most known-about craft today is the Russian deep submergence rescue vehicle, the AS-28, a Priz-class deep submergence rescue vessel. Its main role is to rescue submariners in the event of an accident, and it is deployed from a mothership. It is 13.5m long, 5.7m high, and can operate down to a depth of 1,000m. It has distinctive colourings of orange and white, but of course dark-grey paint would make it a dual-purpose craft.

With numerous designs either in operation or in the construction phase, or still on the drawing board, mini-subs are continuing to evolve. They are an aggressive item of equipment with their role to undertake surveillance, gather intelligence, insert raiding parties or launch combat divers to attack targets in docks and harbours. If they are not doing these things then they are an expensive piece of equipment to have waiting for action. The small submarine that can launch torpedoes, and so have a dual role, might be an option for some countries – but being small does limit the operational duration. In a world with fluctuations of stability the mini-sub will continue to have a role.

CHAPTER FOURTEEN

COMBAT DIVERS' EQUIPMENT

Diving equipment is a growing market and, if including the recreational diving community, it is a billion dollar industry. Open-circuit, semi-closed and closed-circuit breathing systems are available to all who have the money to purchase and can be trained in their use. While the technology is there, military equipment has to meet a more exacting standard, so those offering such systems will vie for a place in a more restricted market. For the military diver, rugged and reliable is the name of the game!

Diving suits

The body covering is an important matter for the combat diver – with two options to be considered dependent on the location to be dived: drysuits and wetsuits. In cooler and cold environments the drysuit offers the best protection, as the clothing worn underneath can be adapted to the actual conditions. In the tropics, or warm water locations, a wetsuit will be a better option and, with various thicknesses available, the needs of the diver can be met. The military versions of either suits are strengthened at the knees and elbows, have good and easy access, and are easily repairable. The colour is usually black, but there are camouflaged options. In addition there are combat swimmer drysuits for those on surface swims, and immersion suits that can fit over full combat dress, including boots.

When the diver enters the water the drysuit hugs the body as air is pushed upwards, and in regions where the water is cold there is the first onset of the lower temperature registering with the brain. The suit now clings to the body, and to remove the last of the trapped air the arms can be raised up and a cuff pulled to allow air out. Most suits have a control valve that does the job when the wearer pushes a button. Buoyancy is crucial, and the diver has to be able to adjust this for maintaining depth; too heavy and they descend, while too light means they go to the surface. There is the added factor that buoyancy is affected by salt and fresh water, and so when working in an area where sea water meets river water that difference has to be compensated for. In a very cold environment working parts on divers' equipment can freeze and make them inoperable.

Former SBS operator Paul Haynes describes some of the other equipment worn to protect the diver from the environment, and other combatants:

OPPOSITE
A diver using open-circuit breathing apparatus dives under the ice and has a lifeline connecting him to the surface. Extreme low temperatures can cause dive equipment to freeze as well as the diver if not insulated. (US Army photo by SSG Eliverto V. Larios)

ABOVE
A Danish combat diver in a dry suit having completed a dive. The air has been pushed out by the water pressure, causing it to crinkle against the body. Note the zip across the back to allow entry into the suit. The diver has additional weights to allow negative buoyancy when in the water, which can be adjusted during the dive. (Danish Armed Forces, Henrik Palshøj)

Worn over the drysuit may be a climbing safety harness and an ergonomically tailored equipment load carry ballistic protection system to enable for example the stowage of ammunition, personal radios, field knife, demolitions equipment, tactical lights, respirator and emergency location tactical beacon and strobe. Clipped onto this load carry harness will then be the operation specific life support system and a buoyancy control device. Personal weapons could consist of an assault rifle together with a side arm. In addition, a shotgun with solid lead projectile ammunition for breaching operations may be carried. For ballistic protection during any land phase, the Tactical Diver may be wearing a highly advanced composite material ballistic protection helmet and worn on the torso, ceramic plates that protect vital organs from high velocity projectiles such as small arms weapons.

Navigation

The combat diver tasked with a beach reconnaissance mission has to navigate and swim to an enemy's, or potential enemy's, beach to gather information while remaining unseen and unheard. To aid the task there will be additional equipment to enable them to undertake the job, such as a swim board for navigation and depth monitoring, cameras, measuring tool, sat nav, as well as a method of recording the data gathered. The surf zone will create its own problems with surges as waves break, then draw back, and where the surf is roughest the diver can be tossed about – not ideal for gathering information.

From the origins of beach surveys, technology has evolved to provide the combat diver with an all-in-one mobile reconnaissance system. An example of this is the Shark Marine's Dive Tablet 2, which is a modular system allowing it to be adapted to each mission's requirements, and it is designed to be robust enough so as to endure the rigours of being a special forces piece of kit.

In operation it enables the diver to navigate and see underwater regardless of the conditions, and allows them to focus on the mission. Having access to underwater navigation and mapping, rapid beach profiling, evidence documentation and geo-referenced photography makes it a valuable tool. This is achieved through the DiveLog software, which is the central element of the Tablet 2, which integrates mission planning, post processing, report generation, navigation, sonar control, video control, communications, and even vehicle control in one piece of software. All of this alleviates the need to have different software for each piece of equipment or task.

The TacScreen is specifically designed for combat navigation and provides the operator with crucial information at a glance, such as depth, speed, heading and current, as well as guiding them along a route or to a target. The Rapid Beach Profiling System allows a diver to collect bathymetric data and generate profiles of a beach or potential amphibious landing zone.

ABOVE LEFT
The Navigator can be used and operated by a single diver but is larger and has more functions than the Dive Tablet 2. (Shark Marine Technologies)

ABOVE
The Navigator provides a visual data screen and has easy access control management. (Shark Marine Technologies)

The larger, heavier and more complex version is the Navigator, which has a sonar imaging and navigation system designed with the lowest possible magnetic signature, and so is suitable for mine clearance operations and can be fitted to SDVs. The company has developed the MAKO Diver Delivery System as a combination of diver transportation and the Navigator. The system is capable of identifying targets, and complex survey and reconnaissance missions, while providing the diver with full navigation and forward-looking sonar viewing, and can locate targets up to 300m away.

The MAKO can be flown in manual, semi-autonomous and fully autonomous modes while carrying one or two divers, and towing up to four additional operatives. Unlike standard Diver Propulsion Vehicles, the MAKO uses vertical thrusters that allow it to adjust its pitch and roll and maintain depth while stationary.

Closed-circuit rebreather

Open-circuit equipment is the most familiar rebreather equipment, either with tanks of breathing gas, or an umbilical hose from the surface. It sends a mass of bubbles to the surface every time the diver breathes out, which for many military tasks is not a problem; however, the diver on a covert mission does not want a trail of bubbles identifying their presence, so uses a closed-circuit breathing system where the breathing gas is recirculated within the apparatus and therefore no tell-tale bubbles are released.

Cobham Mission Systems in the UK is one company that produces rebreathers that are in service around the world, providing increased capability to special forces divers and enhancing their mission effectiveness by providing both oxygen and nitrox breathing options.

The MR3400 Multi-Role Special Forces Diving Apparatus S-24 Combi is a self-contained chest-mounted system for shallow water and covert operations. While underwater the diver can switch between closed-circuit mode, using

ABOVE
This image of military divers using open-circuit breathing apparatus shows the issue of expired air, as it expands when rising to the surface. This would give the covert diver away and so equipment that does not release any bubbles is used. (US Naval Special Warfare Command)

ABOVE RIGHT
The diver is using the tried and tested Draeger closed-circuit oxygen rebreather. As the combat diver leaves the water, his mouthpiece can be released and the half mask removed when safe to do so. If he has to get away quickly he just puts the mouthpiece back into his mouth and submerges, then the mask can be refitted. (US Marine Corps photo by Lance Cpl Ethan Green)

100 per cent oxygen for up to an 8m dive depth, and a semi-closed-circuit mixed-gas mode up to 24m dive depth, with a carbon-dioxide scrubbing duration of 240 minutes where the carbon dioxide is removed from the recycled gas. The ability to switch gas modes while underwater greatly expands the operational capability of this rebreather, and it means that the diver can remain underwater and unseen throughout the mission.

Because of the ability to switch between mixed gas and oxygen it is possible that a diver using oxygen could encounter a situation where there is a requirement to dive deeper than the safe depth for breathing oxygen. With this system the diver would simply switch over to a mixed gas and dive deeper to continue the mission. Such a system would be very appropriate for use with underwater vehicles where depth changes could be required for operational or sea condition reasons. The system has a low profile and is of a modular configuration to meet

RIGHT
The MR3400Multi-Role/Special Forces Diving Apparatus S-24 Combi. (Cobham Mission Systems)

The Viper back mounted system in operational use. (Cobham Mission Systems)

a variety of operational requirements, as well as having a low work of breathing. These breathing systems have to be both rugged and reliable, which is vital for the diver, and they have to be user maintainable in the field.

The MVP Modular Viper Platform is of the same rugged standards, but is a low-profile self-contained back-mounted rebreather developed specifically for mine countermeasures, as well as covert operations from very shallow water to depths of 100m. The modular packaging allows for mission profile configurations using mechanical gas-mixing technology or electronic technology.

The current Viper system is in service in more than 14 countries, and is routinely used in all environments from the Arctic to the Equator. Cobham is also the manufacturer of the US Navy MK 16 electronically controlled underwater rebreather. Paul Haynes from JFD explains:

> Electronically controlled rebreathers offer the optimal breathing gas management solution as they extend diving durations whilst limiting the detrimental physiological impact of excessive oxygen and nitrogen exposure. Using oxygen sensors, electronically controlled rebreathers monitor the oxygen level in the breathing gas and send their signal to an electronic oxygen control sub-system. When the oxygen level drops below a pre-set level (set-point), the electronics automatically open an oxygen addition valve to 'top up' the oxygen in the breathing gas. However, to enable deeper diving, during the descent, a diluent sub-system mechanically adds a diluent gas such as air, which includes a certain amount of nitrogen so the diver is not breathing 100% oxygen. By electronically monitoring and automatically adding oxygen when required, there is no need to vent excess nitrogen (inert gas) into the water. Such systems are therefore frequently referred to as closed-circuit mixed-gas rebreathers. When using the appropriate amount of

A Shadow back-mounted closed-circuit tactical diving life support system offers a five-hour duration and has been optimised for use with Tactical Diving Vehicle (TDV) operations and a seamless transition from water to land phases of the operation. Note the mask-mounted peripheral vision digital diver navigation system. (JFD Marine)

carbon dioxide absorbent, by electronically monitoring the life support system consumables resource, closed-circuit mixed-gas rebreathers can facilitate extended Tactical Diving Vehicle operations of up to ten hours or more.

Underwater communications

The question of underwater communications has been, and remains, a major issue – particularly for special operations divers. Military rebreathers use a mouthpiece which is gripped between the teeth, and that alone affects any effort to speak, and while a full face mask might help the situation, it does not help the diver. The solution would be an oral nasal mask which fits around the nose and mouth, where a microphone can be fitted, but they are used inside a full face mask which is held to the face with spider straps tightened to ensure a snug fit. A combat diver leaving the water can easily remove a half face mask and just spit out the mouthpiece to rest on the top of the beathing set or chest, allowing them to have their weapon in the ready-to-use position. If the diver for any reason has to make a rapid exit they can put the mouthpiece into their mouth and submerge into the water and then replace their half mask.

Commercial and military divers using more conventional equipment can have a breathing medium such as air or a mixed gas supplied from the surface through an umbilical. The umbilical also contains a communications cable that allows the diver to speak to the surface and vice versa, but without that hardwire link there is a problem, and the greater the distance the greater the problem, as radio signals don't travel far through water. However, sound travels great distances underwater, so organizations are developing acoustic technology which transmits data as sound, in a similar way to an old dial-up computer modem. As sea life can be sensitive to underwater noise, the technology needs to take this into account. Although the signal can be intercepted, the data itself can be encrypted. The underwater acoustic network links with surface buoys in much the same way as a mobile phone network uses cell towers. The surface buoys can then communicate with satellites, giving divers and submarines access to land-based networks.

In 2017 NATO set the international standard for underwater acoustic communications. Named JANUS after the Roman god of openings and gateways, it should make it as straightforward for a device to connect to the acoustic network as it is for a land-based device to connect to wi-fi.

John Potter from NATO's Centre for Maritime Research and Experimentation (CMRE) describes it as:

> a digital underwater signalling system that can be used to contact underwater devices using a common format; announce the presence of a device to reduce conflicts; and enable a group of underwater devices (that can be underwater robots, submarines, divers or any other equipment operating under the surface) to organize themselves into a network.

Jim Knudson, programme manager for the US Special Operations Command said:

> A small, body-worn device could give operators increased communication and situational awareness capabilities… we are looking to make it compact, not a big bulky system but a wrist-worn, compact, smartphone-type effort that can be attached to the diver's body. That system will also need to provide operators precise location information… we need to have a good track of direction of where we are headed without floating too many buoys… we are trying to figure out how do we get that good accurate GPS tracking.

Using a smartphone-type device will allow divers to use text and specially designed emojis, rather than needing to speak. With much technology designed for the military eventually finding its way into the civilian market, it probably won't be long before recreational divers can text and post selfies while on their dive.

Jetboots

Tides create a flow and ebb movement in our oceans and seas, creating currents that can travel at speeds up to 8 knots or more. Strong winds can add to currents that are at or near the water's surface, and near coastal areas tend to drive currents on a localized scale. All of this matters to a diver because the direction of the current can dramatically affect the diver's movement through the water. Get it wrong and the water can push the diver in the opposite direction to where they want to go. Even a slow current can affect the diver, who will have to fin harder to make progress, and on a long swim it can impact even on the fittest, which is why diver propulsion units are valuable items of equipment.

On occasions when it is not possible or practical to use a larger form of diver propulsion unit, the operators can utilize Jetboots, which are a unique propulsion system designed to be fitted to the diver, who can control their operation. A unit is strapped to each thigh, with the diver having a control box which leaves their arms free. They can be fitted for a water parachute drop, or when jumping from a helicopter, and be ready to use once the diver is in the

A US Marine with the 31st Marine Expeditionary Unit's Force Reconnaissance Platoon wearing Jetboots, small propulsion units located on each thigh, which helps propel the diver forward, allowing them to move through water at a faster rate. (US Marine Corps photo by Lance Cpl Ujian Gosun)

water. They can also be worn when operating from a Swimmer Delivery Vehicle, or mini-sub, to aid the final part of the insertion, and they can remain in place when the diver is on land. The system is designed to complement the use of SDVs and Diver Propulsion Devices, not replace them.

Military personal watercraft

The Maritime Special Operations Forces (MARSOF) of the Netherlands Marine Corps utilize personal watercraft – often known by the trademarked names Jet Ski, WaveRunner, and Sea-Doo – as a frogmen transportation system carrying a driver and two frogmen, one on the sled, to a drop-off point where they can deploy for the underwater swim to the target. The personal watercraft (PWC) is adapted for military and special forces use, and it will be noted that the high water jet that emanates from the civilian craft is eliminated in the military version. This system was used to deploy two frogmen in the Dutch SF anti-piracy mission described in Chapter 10.

H.I. Sutton, author of *Covert Shores*, has identified that US Navy SEALs use modified two- or three-seat Yamaha FX Cruiser SHO WaveRunners, which are almost 3.5m long, and can transport 1 to 3 people. They were modified with inflatable collars to improve lateral stability, increase shock absorption and provide additional floatation. These machines are fast and highly manoeuvrable, and capable of being used in shallow water. He also explains that the Jet Ski found favour with Iran's Revolutionary Guards, who have a fleet of hundreds of small craft, from speedboats to Jet Skis, which are used in intimidation attacks and ship seizures as part of the actions taken by Tehran against Western targets.

CHAPTER FIFTEEN

WEAPONS UNDERWATER

The striking picture of a combat diver leaving the water, weapon raised into the ready to fire position, indicates that the diver or surface swimmer has arrived at the beach and, with water dripping from them, is ready for action. But, unless the weapon has been carried in a waterproof bag it will be full of water, and that includes the magazine. Then, at the beach, the diver will have to take the weapon out of the bag, but on a covert mission there is the question of what to do with the bag: fold it up and stow it away, or discard it, both of which can compromise an operation. The unprotected weapon means that the diver has quick access to it, but the weapon will be flooded, so it must be drained of water before use. That in turn is dependent on the design of the weapon and the ammunition being used.

Military weapons are designed and manufactured to endure harsh use and be very reliable – that includes being submerged in water, as well as being subjected to all manner of other environmental conditions. In normal situations the weapon is kept dry and clean to enable it to be fully functional, but military operations are not generally normal. While most military weapons offer a good degree of corrosion protection, some diver units procure weapons with protective coatings, and magazines that are modified to include drain holes. The bottom line is that the water needs draining because that is how the weapon performs at its best.

For a diver or swimmer the weapon will be used in an out-of-water situation, as firing a weapon underwater has its own complications. The bullet comprises four elements: the case is the container that holds all the other components together, and is usually made of brass, but can be steel or copper; the primer in the base of the case contains an explosive chemical compound that ignites the third element, the gunpowder, when struck by the weapon's firing pin; the gunpowder detonates to force the fourth element, the bullet, along and out of the barrel. When unused the bullet itself is watertight. Out of water, the gas emitted from the gunpowder when fired pushes the projectile along a clear barrel, but underwater that action is hindered by the density of the water, which slows the action down. The gas can build up to an extent that it can damage the barrel or, if fired without a problem, will dramatically slow and reduce the range of the bullet. The weapon and its ammunition are designed to be used with a clear and clean barrel, so a barrel full of water takes it out of its design zone.

German combat divers, *Kampfschwimmer*, are ready for action while below the surface. Modified weapons and bullets for use underwater are evolving. (Headquarters of the German Navy)

The most basic action for the operative once sufficiently out of the water is to tip the weapon down and allow water to drain out – but consideration has to be given to the type of weapon because water has probably reached other working parts that are slower to drain. The magazine and automatic loading could also be affected by water, which could in turn affect the operation of the weapon. As soon as circumstances allow, weapons that have been submerged need to be inspected, cleaned and lubricated as corrosion can soon affect the moving parts of a weapon. An ammunition round is a sealed unit during manufacture, but after being submerged it needs to be dried and cleaned along with the magazine. This is to safeguard the stability of the bullet – the insertion and extraction of the round in the breach and the magazine need to work to feed the rounds to the weapon when firing.

An example of a combat diver's weapon is the Heckler & Koch G36K, which is a modular weapon system made almost entirely of a strong, carbon-fibre-reinforced polymer, and it uses a simple operating rod gas system. It is an ideal choice for divers due to its light weight and short length. The barrel is chrome-plated steel manufactured using HK's cold-hammer forging process for a long service life and accuracy. The receiver, trigger, butt, handguard and carry handle are made of corrosion-proof polymer with stainless steel inserts, and the magazines are made of translucent high-strength polymer, all of which provide some advantage in the sea salt environment in which combat divers generally operate.

Heckler & Koch developed the HK416 for US special operations forces, which uses the gas piston system originally used on the G36. The HK416 is designed for harsh environments, including corrosive maritime conditions. A high-quality steel is used to manufacture a barrel that provides superior accuracy with minimal degradation of muzzle velocity. The combat diver HK416 variants are designed so that they can be safely fired after being submerged in water and not completely drained. There is also a corrosion-resistant steel magazine to improve reliability.

Another contender is the Colt Canada C8A2 carbine, which has a short barrel and adjustable stock, and is proven in harsh combat environments. It has a cold-hammer-forged heavy barrel, which gives it a much longer service life than many other rifles. As with all such weapons it can be fitted with a range of different optics and accessories to meet operational requirements. The UK Special Forces and 43 Commando Royal Marines have adopted the Colt Canada L119A1/A2 as the standard weapon fit, but the combat divers will have access to the wide selection of weapons suited to underwater operational needs.

A Heckler & Koch rifle, the MR 762 was used while flooded and it fired safely without any issue, which supports the manufacturer Heckler & Koch's claim that the rod actuation of the bolt, instead of the former AR-type direct gas operation of the bolt, allows for venting which would not be possible in a gas-only system. The venting action is important so as not to trap gas or fluid which can cause overpressure in the breach. The rod design also has other significant advantages such as keeping the breach, bolt area, and the barrel clear. An HK promotional demonstration/comparison shows their weapons being fired safely when flooded with water without any problems, while a standard AR, gas-operated weapon being fired received damage to the breach. This supports the view that it is incorrect to say that a weapon cannot be fired underwater, but it is dependent upon the weapon system and its design criteria.

With the increase in the number of combat divers and amphibious capable units there is a requirement for weapons that can be used without having to allow them to drain first. The system that allows this is called 'over the breach' (OTB), which is a modification made to a weapon by the manufacturer. However, tests of a weapon's ability to be used with water inside it, even if they have been OTB adapted, have shown some deformation or even damage to the barrel. The larger the calibre of the weapon the less of a problem because water drains from the barrel quicker – such as with a 7.62-bore OTB weapon against a 5.56 OTB weapon. The situation remains that if the gun goes underwater then there is a need to clear the barrel by raising the weapon above the water and pointing it down while opening the breech to eliminate any vacuum effect, and to load a round.

Apart from using the weapon when it has been immersed in water there is the well-debated question of what happens to a bullet that is fired into the water. With conventional bullets water does have a great detrimental impact

on performance to the extent that, when the bullet enters the water, it begins a rapid slowing down to the point of not being effective in harming anybody after about a metre, and the flight can be affected so that it follows an erratic trajectory. Discovery Channel's 'MythBusters' performed experiments to test the effects of a bullet through water by shooting into a specially created water tank with a variety of weapons, including a 9mm pistol, a shotgun, an M1 Garand semi-automatic supersonic rifle, and a 50-calibre rifle. Firing vertically down into the water-column revealed the detrimental effect water had, and in some cases bullets simply disintegrated into a mass of particles in a matter of feet. The shotgun slug had the most dramatic effect because its impact with the water had an explosive reaction that actually broke the tank. The overall outcome was that being underwater would protect a person from bullets fired from most rifles. The experiment was then adapted because in real life a weapon is rarely fired from a position directly above the water, but at an angle of about 30 degrees. The result was that for an individual being underwater in the range of 0.9–1.5 metres a bullet from most guns will probably not kill them. The answer is to get below those depths. However, the military seeks a weapon that fires bullets both above and below the water without the water impacting performance.

The Norwegian ammunition company DSG Technology has moved into the high-tech design and manufacture of specialized ammunition to meet the operational requirements of combat divers, with CAV-X small arms ammunition. It can be used by diver teams to engage the enemy while underwater, thereby allowing operators to remain covert.

There are two variants of the ammunition: the A2 and X2. The A2 is designed to be fired into the water from the surface or air, allowing defenders to engage enemy combat divers, unmanned underwater vehicles (UUVs), or SDVs. An additional benefit is that the bullets do not ricochet when hitting the water's surface above a five-degree angle. The X2 has been designed to be fired by combat divers already underwater, allowing them to neutralize enemy sentries while maintaining the clandestine nature of an operation.

The CAV-X supercavitating ammunition is classified by the company as a multi-environment ammunition and is suitable for use in partial or fully submerged weapons, regardless of whether the target is in water or on the surface. It is unclear whether it is suitable for use with all weapons.

The company says that the extreme precision and finesse involved in producing the new ammunition forced them to change direction from being a traditional ammunition provider to becoming a high-tech company. Because of the CAV-X specifications they had to locate companies producing parts for the space industry, as nobody else could meet the engineering tolerances required. A supercavitating bullet works by encasing itself in a bubble of gas, which decreases the amount of skin friction drag on the bullet, so it is only the tip which is in contact with the water.

DSG's chief science officer Odd Leonhardsen explained that the gas bubble and its supercavitating effect is created by the speed of the bullet coming from the chamber, and the reason the bullet does not stop in the same way as conventional ammunition is because the CAV-X projectile is perfectly balanced through its own rotation.

He also said that DSG is selling the bullets to governments around the world – but does not specify which ones – and that those countries were testing the bullets by firing them from a helicopter into water. He qualified that the bullets would only be sold to NATO member countries and that they would not be available to the public.

The US Department of Defense's Combating Terrorism Technical Support Office are involved in the testing process, particularly a .50-calibre CAV-X bullet that can reportedly travel 60 metres underwater, and can penetrate 2cm of steel when fired from 17 metres away, indicating that it might have the possibility of penetrating submarines – if only a mini-sub or SDV.

The Russians have continued to be very active in developing weapons that can accommodate operational use in water and on land. The APS-5 underwater assault rifle was introduced in 1975, and was essentially an underwater AK47 with a distinctive stepped curved magazine. Range of the weapon was almost 30m and it had a magazine capacity of 26 rounds. The magazine necessitated a moving bolt, so the receiver was modified to have large holes in it to allow the displaced water to escape when used. This reliable weapon has been the most formidable underwater personal weapon for many years, but underwater it poses issues because of the size of the magazine and the effect water has on it when manoeuvring.

Russian combat divers firing an automatic weapon while underwater. (Russian Federation Ministry of Defence)

The original APS was followed in the 1990s by the APS-DM, which differed in that it could be used both underwater and above the surface, providing the combatant with much greater utility. Its twin magazines accommodated both 26 rounds (bullets) or 5.4mm darts, which have a maximum effective range underwater of less than 30m, and standard 5.45mm x 39mm cartridges.

A yet more modern Russian proposition is the ADS, which is again capable of use above or below the surface of the water. The ADS amphibious assault rifle is said to be in use by Russian Naval Commandos. TASS, the Russian media, reported in 2013 that ADS production has been set up, and the delivery of the first batch of the assault rifles under the state procurement order has been completed.

The ADS was designed by Russia's Tula Instrument Design Bureau, and is equipped with a 40mm grenade launcher, which has a range of 400m and fires various modifications of the VOG-25 grenade. The rifle uses the standard Russian 5.45mm x 39mm M74 cartridges, but has specialized bullets for underwater applications. The bullpup layout has been adapted to provide shorter length compared to traditional profiles, with the same barrel length and better balancing, while also eliminating stock folding/unfolding operations. The ADS can adopt a suppressor and optical sights.

The specification shows the weight of the gun, including the grenade launcher but without the sight, as being approximately 4.6kg. The weapon has a firing rate of 700 rounds per minute, with a range on land of 500m. The weapon's effective underwater firing range when using the specially designed bullets is about 25m at a depth of 5m, and 18m at a depth of 20m. Fired cartridge extraction to the forward makes ambidextrous shooting convenient.

The true underwater weapons that have been developed and used operationally are pistols, and do not use bullets. Following World War II, the Soviet Union created battalions of combat divers within Spetsnaz and other diver units as offensive and defensive units. They discovered that taking the AK47 underwater and shooting with it created massive problems, and even when it worked it was not very effective, and certainly short range. I have not discovered any evidence that a diver was actually shot and killed in a diver-to-diver conventional shooting action. Instead, the former Soviet Union developed the SPP-1 underwater pistol – Spetsialnyj Podvodnyj Pistolet (Special Underwater Pistol) in the late 1960s. Over the years it has been upgraded to the SPP-1M, and is still in service with Russian Navy special forces divers, and available for export to approved clients.

The pistol is a non-automatic, manually operated handgun, with four barrels which are hinged in the same way that break-open shotguns work. For loading, the barrel cluster is opened downwards to expose the chambers, and a four-round clip is inserted, with one round in each barrel. There is a double-action trigger so that by pulling the trigger the weapon is cocked, while simultaneously selecting the next unfired barrel. There is a safety lever that controls the safety, fire and reloading status.

As conventional ammunition is fairly ineffective underwater, the SPP-1M uses specially designed cartridges, with 4.5mm-calibre steel darts, around 115mm long. It is claimed by commentators to have a 'lethal range' in water of between 6 and 17m, depending on the depth. It can be used out of water, but as its barrels are not rifled its accuracy is very much affected.

Heckler & Koch designed a similar weapon in the 1970s. The HK P11 is bulkier than its Russian counterpart, but it has a five-round capacity and a larger calibre of dart, which probably makes it more lethal.

The HK P11 pistol is not self-loading, but uses a quick-detachable cluster of five barrels, each factory-loaded with a powder charge and long, drag-stabilized darts which are 117mm long. The pistol is reloaded by replacing an entire barrel cluster, meaning that in a combat situation the empty clusters are discarded. Loaded barrels are protected from salt water by thin diaphragms, which are destroyed by the dart at the instant of firing. The charges in each barrel are ignited using electricity, provided by batteries stored in a sealed container in the hand grip of the pistol.

As with the Russian weapon the effective range underwater decreases with depth, and for the HK P11 is about 15m when near the surface. Out of the water it is estimated that the effective range is about 30m, but for the same reason as the SPP-1M the accuracy cannot be assured.

Combat divers will generally have their rifles slung over their backs to have both arms free when swimming. They would unsling the weapon, if appropriate, at the beach or other target area where they would also remove fins to hook onto a belt. In this situation they would be able to drain the weapon as they cautiously move ashore, allowing them to engage an enemy should they have to take that action. In the majority of cases the diver will want to get clear of the water without having to take direct action, because the water/land interface is not the best place to engage in a shoot-out. Having a bullet-firing weapon that can be used both in and out of water will be a valuable asset.

An SPP-1 underwater handgun and darts. (Russian Federation Ministry of Defence)

CHAPTER SIXTEEN

MARINE MAMMALS AT WAR

Imagine a 90kg sleek streamlined mammal moving effortlessly through the water, cruising at 6 knots, its inbuilt sonar seeking out that which should not be there. Amid the warships and cargo carriers berthed in the naval dockyard, the patrol below the water's surface continues, silent and efficiently.

The enemy mini-sub had left its parent craft and moved up into the dock area, evading the outer defences before bottoming out as the enemy divers put on their equipment and prepared their mines. When they were ready they entered the chamber that allowed them to flood it to equalize the pressure of the water outside. In the murky darkness of water the divers, in pairs, adjust to the environment and check compass directions. They then begin the swim to selected targets, the leader of each pair breaking the surface only long enough to get a fix and identify any hazards. They then continue, their fins pushing the water behind them as they move, encumbered by the weight of the limpet mines they carry.

Above, the guards of the port have seen and heard nothing of the attackers, but under the water, in the gloom of muddy water and night-time darkness, the guardians have sought out the intruders. No recognition signal emits from the attackers, and as all friendly divers carry these, they are automatically deemed to be the 'enemy'. Moving effortlessly through the water at a conservative speed, the creature of infinite beauty and of an intelligence level next to man uses its sonar to make the final adjustment and powers itself up to a speed of some 30 knots. The distance is short, but far enough, as the entire weight of the dolphin rams the enemy diver. Communication between the dolphins enable them to each single out a target. Within moments, the threat is nullified, their mines fall uselessly to the bottom of the dock, unarmed. The dolphins, having disposed of the enemy, break the surface, alerting the guards. Trained not only to destroy the targets, they then retrieve the bodies to the surface, where the guards in boats are able to recover them for identification.

Alerted, the defence organizer dispatches another of the dedicated underwater search group. This time the dolphin uses its sonar to search the harbour bottom, to seek out the divers' delivery vehicle and, when found, it

moves forward to meet it. The mammal is encumbered with a harness, onto which is attached a limpet mine. The dolphin rolls effortlessly over as it passes the craft, and the powerful magnets grip to the steel hull, simultaneously releasing the mine from the harness. The mini-sub continues to re-join its parent craft and both move out to sea, knowing their teams of assault divers have been lost, but not how. The vessel now has to evade the enemy who is searching for them – until the detonation of the limpet mine is recorded and a search by warships in the vicinity finds no survivors, only debris, which when recovered is found to have come from an enemy submarine.

Imagine in another scenario the years of careful training and planning come to fruition as the graceful dolphins depart the divers and move towards the distant port. The harnesses marginally slow the mammals down, as their sonar seeks out the harbour entrance and the distant ships. Diving deep, they pass any anti-diver devices and move in amidst the steel hulls of the enemy ships. Their movement through the water has left no trace, and alongside a ship, a mine is clamped on, armed with the movement through water as the dolphin swims to the target. It detaches from the harness allowing the next mine to be deposited. The four dolphins each carry two mines and now, as they depart the port area, eight ships are primed for destruction. The excited clicking of the dolphins is heard by the submarine and the boat's underwater divers lock-out to meet them. In a specially adapted chamber added to the submarine dolphin and man are at one again, and, their harnesses removed, the dolphins receive a reward. The submarine departs the area, diving deep and running fast to avoid detection and be well clear of the area when the charges detonate, sending eight ships to the bottom of the sea, their cargoes of specialist assault troops and equipment lost to the next battle.

The two scenarios are, of course, completely fictional, and if we remove the ethics of whether the military should or should not be training mammals from the equation, there have undoubtedly been growing developments and experiments between man and highly intelligent dolphins in some countries, and there are speculative reports that some have trained dolphins to undertake these aggressive tasks. However, as an overview, countries such as North Korea, Iran, and possibly China could have dolphins trained for such purposes within their military arsenals.

The US marine mammals programme

The US Navy developed a research programme back in 1963, so that they could study marine mammals' specially developed senses and capabilities. In particular, their sonar and their deep-diving physiology were of great interest. They also wanted to know if dolphins and sea lions could be trained to undertake underwater tasks, either in support of, or in place of, human divers. The first base for the Navy Marine Mammal research unit was at Point Mugu in

California, USA. It was a very modest establishment in terms of research and development, but it was to grow as the programmes developed. The demonstration that trained dolphins and sea lions could be worked untethered in the open ocean, with great reliability, was a major achievement. It was a high risk because the creatures could just depart and not return, taking their chances in the oceans.

Research took place into the capabilities of marine mammals, including the development of improved techniques for the diagnosis and treatment of their health problems. There were neurophysiological studies using behavioural and other non-invasive techniques, to gain a better understanding of how a dolphin brain functions. Supporting this research was the development of

ABOVE
For long distance travel, sea lions ride in specially designed kennels, are kept cool, wet, and comfortable, and have vets on hand. (US Navy photo by Mass Communication Specialist 1st Class Kathleen Gorby/ Released)

RIGHT
Dolphins have played an important role within the US Navy with regard to search and recovery operations. (US Air Force photo/Staff Sgt Nicole Leidholm)

instrumentation for determining brainwave activity, the hearing range of a dolphin, and how dolphins produce the sounds they make. They also undertook research into the dolphin echo-location system, and were heavily involved in evaluating and developing marine mammals to undertake work tasks which would be more suited to them than to human divers or deep-diving submersibles.

Training marine mammals to carry out tasks underwater is time-consuming. When the initial phase is completed, the animals will have reached the point where operational training can commence. In the case of sea lions, they were fitted with a tether so that the trainer retains control. At the end of the tether, the sea lions descend to depth to locate the source of a pre-positioned pinger. The animals then press a rubber pad to indicate that they have reached the object. All this is undertaken in very controlled conditions, but the real test begins when the trainers take their charges to open water. This phase of the training programme is critical as the animals have to work in open water and, after initial dives, without a tether. They also have to respond to a recall signal which means that they have to want to participate, or they just keep swimming.

All US Navy maritime animal training is carried out using positive training measures with food as a reward, which means that animals are rewarded with fish for performing their tasks correctly, but they are not punished if they fail. This system of training and working has proved effective, because without a relationship of trust the dolphins and sea lions would simply escape when taken out to sea and released to undertake dives. Statistics show that in the course of 30 years of untethered training only seven dolphins failed to return to their enclosures. It is worth noting that all the research and training programmes undertaken by the US Navy have used already captive animals that have been rescued from tourist entertainment centres where for the most part they were abused, and no mammals were taken from the wild. Once trained to undertake tasks, they worked in the open sea and could, if they desired, just continue to swim away. With dolphins living in large sea pens they could easily just jump over the net and swim out to sea. Some have over the years, but most maintained a strong bond with their trainer and stayed.

The Reconnaissance and Interdiction Division at NIWC Pacific manages the Navy's Marine Mammal Program, which trains bottlenose dolphins and California sea lions to detect, locate, mark and recover objects in harbours, coastal areas and at depth in the open sea.

Today, the US Navy relies on two species: the bottlenose dolphin (Tursiops truncatus), and the California sea lion (Zalophus californianus), and both are known for their trainability and adaptability to a wide range of marine environments. They can travel to remote work sites, where for short distances they are trained to either swim alongside a small boat or ride in the boat itself. For longer trips, animals can be transported by sea on naval vessels or by air in planes or helicopters. A veterinarian oversees the comfort and care of all the animals while each is constantly monitored by an experienced trainer.

A sea lion working with a combat diver, locating underwater objects. (US Navy photo by Mass Communication Specialist 1st Class Kathleen Gorby/ Released)

The US Navy Reconnaissance and Interdiction Division continues to use marine mammals because:

> Dolphins naturally possess the most sophisticated sonar known to science. Mines and other potentially dangerous objects on the ocean floor that are difficult to detect with electronic sonar, especially in coastal shallows or cluttered harbours, are easily found by the dolphins. Both dolphins and sea lions have excellent low-light vision and underwater directional hearing that allow them to detect and track undersea targets, even in dark or murky waters. They can also dive hundreds of feet below the surface, without risk of decompression sickness or 'the bends' like human divers. Someday it may be possible to complete these missions with underwater drones, but for now technology is no match for the animals.

The role that they play includes, for sea lions, the recovery of objects such as Navy equipment in harbours, along the coast and in the open sea and attaching recovery lines to them. The role of dolphins is to search for and mark the location of underwater mines that pose a danger to military or civilian shipping. Both dolphins and sea lions are also trained to assist security services in the detection and detention of unauthorised swimmers and divers who may be intending to injure the Navy personnel, vessels or harbour facilities.

Research also shows that several decades of military classification of the marine mammal programme's true operations has created speculation. The media, and some animal activists, claim that dolphins are being used as offensive weapons. These claims could not be countered due to that classification; however, since declassification of the programmes in the early 1990s the Navy has repeatedly and openly shared with the media and concerned organizations the story of its marine mammals and their missions.

The Russian marine mammal programme

The Soviet Union had a marine mammal programme, centred on dolphins for finding objects and swimmers underwater, and to conduct counter-diver operations. After the fall of the USSR the main dolphin unit was located in Ukraine as part of the Ukrainian Navy, but after separation it was neglected, before being re-established as an operational unit with reports indicating that dolphins had been trained to search for and tag underwater mines or unwanted swimmers attempting to access restricted waterways . Following the annexation of Crimea in 2014, the Russians captured the centre, although it is said that it is unlikely that the dolphins currently form an operational unit.

The idea of suicide dolphins, carrying charges and ramming ships, generates a feeling of revulsion amongst most people, and from a military stand-point they would be an uncontrollable weapon system which could just as easily launch itself against a friendly vessel.

The Soviet marine mammal programme officially closed in the 1990s but President Putin reopened three former Soviet military bases along its vast Arctic coastline. The research and training was done by Murmansk Sea Biology Research Institute in northern Russia to see if beluga whales could be used to guard entrances to naval bases in arctic regions and kill any intruders.

During their research the Murmansk Sea Biology Research Institute concluded dolphins and seals were much more suited to the training and arctic climates than the beluga whales. The whales were deemed too sensitive to the cold and did not have the same 'high professionalism' of seals, which had a far better memory for remembering oral commands.

This image relates to the use of dolphins and sea lions by the Russians; it is widely suspected that they use them to locate 'enemy' divers. The photograph is dated to 1992 and depicts the grim use of these mammals. (Photo by Wojtek Laski/ Getty Images)

North Korea

Further developments have been provided by H.I. Sutton, who reported in the US Navy Institute News on 12 November 2020 that – with evidence based on image intelligence – North Korea appears to have a naval marine mammal programme dating back to at least October 2015:

> Their first appearance was at the site of a major naval display in Nampo, a naval base and port city on the west coast. The animal pens were spotted in satellite imagery in the brown waters between a shipyard and a coal loading pier. Mr Sutton considers that the location may still be in use intermittently, possibly for training with the naval units based nearby. But the main activity moved to a site further up the river on the edge of town. This base, possibly where the dolphins are bred, began its development in October 2016.
>
> Comparisons to the marine mammal pens used by the US Navy and Russian Navy suggest that the North Korean pens are sized for dolphins. It's also possible that the pens are some type of fish farm… But a survey of fish farms suggests that these pens are different, and not consistent with other sites in North Korea.

Up-to-date information shows that marine mammals are being used by a number of countries who have the military expertise and a financial budget to sustain an operational organization. Marine mammals appear to be part of some countries' military inventory until underwater machines take over.

CHAPTER SEVENTEEN

REMOTE AND AUTONOMOUS UNDERWATER VEHICLES

In 1989 I speculated in my book *Combat Frogmen* that:

> underwater robotics may be part of the distant future, and squadrons of autonomous vehicles may not be roving the seas for a few years yet, but technology exists today to develop an Advanced Concept Combat Remote Operated Vehicle (ACCROV), able to undertake covert beach reconnaissance, mine countermeasures, ship attack and defence.

I envisioned that a beach survey operation could begin with the small operations submarine moving close to the shore-line, maintaining enough depth to remain hidden. Its cargo would not be a group of commandos or combat divers, but ACCROVs, stored in transit garages on either side of the boat. The captain would bottom out his craft and, through the periscope, scan the beach for anything that could endanger the craft and its crew. It would be night-time, and the captain would be aided by advanced night-vision equipment. When he was satisfied that everything was secure, he would give clearance to the ACCROVs' operators to begin their task.

Within the submarine, a control room with the latest state-of-the-art electronics would provide systems command function tests for the ACCROVs. Once these were completed, the garage doors would be opened and the vehicles flown out. Although they free-swim through the water, they would also have caterpillar tracks for crawling up on to the land.

Capable of operating in currents of up to 3 knots, they would be navigated by a low-light black-and-white TV camera, onboard sonar and navigation equipment. As they moved towards the beach their course would be plotted, along with any obstructions or mines. The umbilicals pay out, providing control links with the pilots in the parent submarine. Depth readings would be provided through the digital readout, and other information recorded on video tape and still photographs. The cameras would be of an integrated system combining SIT low-light, black-and-white television, a colour TV,

and a still camera, providing the three functions in one system. The vehicle would be a basic modular design with 'add on' equipment pods, depending upon the operation.

For the beach survey the ACCROV would be fitted with the crawler pod, cameras, manipulator for taking sand samples, sonar and other advanced electronic equipment. Having completed its survey of the beach, the vehicle would be backed into the sea and return to the submarine, its valuable cargo of film and samples safe.

Prior to an amphibious landing a number of ACCROVs could be launched, fitted with a variety of 'pods', to crawl up the beach. Any obstructions would be primed with demolition charges, and coloured lights set up to guide landing craft. Other robots would be fitted with machine guns or rocket-propelled anti-mine systems which clear lanes up the beach, allowing assault troops a mine-free passage.

Defending a harbour from covert diver operations is a time-consuming and labour intensive exercise, but each warship could carry one or two ACCROVs, and special patrol boats could also carry them in defence modes. Advanced sonar would seek out SDVs and even divers. The robots would carry weapon pods to allow them to deal with intruders, and would be fitted with an anti-mine system, to locate and identify limpets and dispose of them, as divers are expected to do at present. A vehicle can maintain a 24-hour watch; it would take a considerable number of divers to do the same. The vehicle would be powerful, but as compact as possible, and fitted with the lightest umbilical available. All parts of the vehicle would be modular, to enhance maintenance. Technical electronic and weapons

A larger ROV being deployed for search and recovery operations. (US Navy photo by LT Curtis Khol/Released)

pods would be added to keep in line with future developments and operational requirements. Because of the vehicle's make-up, it would be a viable production model, and could be justified financially.

That was in 1989, so is it still possible that tomorrow's combat diver could be replaced by a machine?

The first non-manned machines to be used for military purposes were those classified as Remote Operated Vehicles (ROV) and used in naval EOD operations and which remain in service with navies throughout the world today. They come in various sizes and are fitted with an array of tools and cameras connected to an operator on the surface through an umbilical. This provides power to the vehicle and allows the operator to remotely 'fly' it and manipulate the tools. In mine warfare operations it can be deployed to search for and locate mines or other unidentified devices and then inspect a suspect object to provide video pictures. Based on that, the surface team can either deploy an EOD diver to undertake a more detailed inspection, or place an explosive charge on the mine which will destroy the mine when the vehicle is clear.

Generally the EOD ROV will be of a smaller type, as ease of launch and recovery is needed for mine operations, and the tethered ROV will have an expanding role to play in mine countermeasures for the maritime domain. Divers and their skills will always be required in the EOD role. The larger ROVs are deployed on search and recovery as well as salvage operations, but that is outside the scope of this book.

Autonomous Underwater Vehicles (AUVs) are unmanned and are pre-programmed in their onboard computer to undertake a task, and with no umbilical they are under the control of the computer. These systems are used for undersea missions and once launched the support crew await its return to the surface. The ability of small AUVs continues to evolve as technology progresses. They are fitted with an array of tools and can be programmed and deployed to survey a coastline, even into shallow depths, and either store the data or transmit it to a control centre via satellite. They can monitor shipping movements in and out of a port and identify any underwater obstructions, with the main restriction on their operating ability being determined by their battery life. Most importantly, they can do this unseen and unheard and the intelligence obtained can be evaluated and used for the planning of covert diver missions.

Large autonomous underwater vehicles are more expensive, but they offer greater capabilities in some missions, applications and operational duration. However, using unmanned underwater vehicles in marine applications poses some challenges, such as being on a fixed pre-planned programme, and unless it has an aerial that can be deployed to the surface its computer cannot be updated to change or extend its mission. There is also always the possibility of a system failure. Interest in AUVs by the military for missions and applications has increased as technological innovation and the evolution of their abilities have enhanced their value.

In the case of AUVs it is their ability to operate at long stand-off distances from their support vessel, to operate in shallow water areas autonomously, and to provide a level of clandestine capability not available with other systems that makes them such a valuable asset. The AUV can be launched from a submarine or surface ship from which it proceeds to the designated surveillance area where it then performs its mission, collecting information over a predetermined period of time. The information it gathers can either be transmitted back to its base or when the AUV is retrieved following its mission.

Consider the situation where special forces divers have reached the beach and begun their mission, but they are limited to the equipment they can take with them. Then there is a mission change which means they will have to remain in the area and survive unseen and unheard throughout the duration of their stay. The craft that delivered them has returned to the mother submarine, which has also moved away to avoid detection; however, an AUV is programmed to move to a location close inshore where the operatives are located, and at a designated spot the vehicle automatically deposits a package on the seabed. The team on shore are contacted through their communications system and they are able to put on their diving equipment and swim out to locate the underwater package, the auto-sub having departed the area. The package is configured in such a way that the divers can take what stores they require and return to the shore, while the package remains on the seabed. The team then have the resources they require to remain at the location until the mission is completed and the divers are withdrawn and the auto-sub can return to the drop point and recover the remains of the package. That scenario could now become a reality when Navy *Lookout* on 31 March 2020 reported on developments within the UK:

> In April 2019 the MoD [Ministry of Defence] published a competition notice seeking proposals to develop an autonomous version of an existing extra-large unmanned underwater vehicle (XLUUV) to be procured under its Defence and Security Accelerator (DASA) programme. The contract was placed with Marlin Submarines Ltd (MSubs).

The DASA specified that the contractor needed to base their proposal on an existing vehicle which could be easily adapted so as to reduce costs and have a quicker delivery time scale. The submersible would need to carry, deliver and recover payloads of at least two cubic metres and two metric tonnes and have intelligence gathering and ASW barrier capability. Designers and constructors of mini-subs do not exist in great abundance but the UK is fortunate in having some of the best in the world. Two existing vessels fit the bill for easily being adapted to be autonomous and for a British requirement can be built within the country.

The 'Manta' is being built to be the Royal Navy's autonomous version of an extra-large unmanned underwater vehicle. (MSubs)

The 'Manta' is based on the existing MSubs 9m S201 manned mini-sub which weighs in at 9 tonnes, having been refitted with an autonomous control system to allow unmanned operations, as well as a modified outer hull. The craft is fuel-cell powered and can be operated for about a week without charging, but the requirement was for a craft with a three-month endurance and a range of about 3,000 nautical miles. The company consider that this could be possible, but would require filling the payload bay with additional fuel-cells which then defeats the objective of the vehicle.

The larger 70-tonne 'Moray' could also evolve into a more sophisticated XLUUV and has the advantage that the X-planes at the stern allow for bottoming the submarine on the sea floor, are quieter and provide more precise control than a conventional cross-form rudder arrangement. Cost would be a factor but the delivery process would be proven and vehicles could be brought into operational service sooner. The larger vessel adds to launch and recovery issues, but of course would have the advantage of a longer operational time frame and be able to carry more equipment and payload.

The proposal is that the extra-large unmanned underwater vehicles will be transported on a surface ship; although a submarine could be adapted to transport them the UK only has a limited number of boats and they have their primary role as hunter killers. The surface ship will have to be able to deploy and recover the vehicles but that is a well-tried and tested method.

Crawler amphibious systems

The world and its technology has changed and evolved dramatically since 1989, especially in the underwater world. At the DSEI Defence Exhibition in Japan during 2019 the US company Critical Solutions International (CSI) introduced two multi-role unmanned amphibious systems. The company

proposed that the systems, named the Sea Otter Marine Crawler and the Sea Ox Marine Crawler, could be deployed either on land or in the sea to undertake a variety of operations. So my vision of a beach crawler appears to be a reality for a range of missions, such as beach mine detection and clearing, clandestine intelligence-gathering, amphibious landing support and, with modular additions, many other missions that are generally undertaken by divers. The company claims that both tracked systems are powered by lithium-ion batteries that enable them to carry out up to 100 days of continuous static observation of an area both on land or at sea, independent of weather or sea conditions.

Both amphibious systems can be operated autonomously through an onboard pre-programmed computer, which controls what it does and when without external input. This is a system that is primarily used for deep sea projects where it is not possible or practical for the system to be tethered to the surface.

However, the crawler system could be remotely controlled via an umbilical to a command vessel – probably a manned submersible that could remain unseen. But an umbilical run out over a seabed with all manner of obstructions could be impractical. The manufacturer claims that the systems can be fitted with a remotely operated communications link that extends out to a distance of 16km when submerged, using a radio system frequency buoy, and 38km when on land. This means that an operator can remain clear of the operational activity while controlling the vehicle during the mission. I did attempt to communicate with the company to obtain updated information on the project, but they did not respond.

US Marines experiment with a beach crawler as a tool for undertaking beach reconnaissance. (US Marine Corps photo by Sgt Paul Peterson)

US Marine Corps CRABs

Military.com has reported that:

> The US Marines want the Crawling Remotely-Operated Amphibious Breacher [CRAB] to replace humans in the traditional UDT mission. According to the US Marines the CRAB will be – autonomous robots designed to operate in the dangerous surf zone, under hostile fire, dismantling formidable beach defences with tools and, very likely, their own bodies […] with front-end equipment – including a mine flail, tiller and rake – capable of breaching or proofing amphibious assault lanes for landing forces.

The plan would be that prior to an amphibious landing there would be a mass invasion of CRABs which would arrive at the beachhead and proceed to efficiently dismantle all obstacles. The detail of how they would do the dismantling is not discussed but it is deemed that the CRABs could be sacrificed in the process.

Military.com further reports that:

> A prototype CRAB drone should be available by 2022, and the Marine Corps Systems Command submitted a proposal to the Office of Naval Research for use for the CRAB system as a Rapid Innovation Fund topic for fiscal 2020. Once approved, MCSC will begin a two-year process of developing a prototype.

There is a historical precedent to a degree. In World War II the British 79th Armoured Division used CRAB tanks to clear minefields using flails fitted to the front which detonated mines and cleared a path for the troops to follow. These were full-sized tanks converted for the purpose, and they were successful. The Marines currently rely on the Assault Breacher Vehicle – an M1A1 tank chassis with a mine plough and mine-clearing line charges, which are rocket-fired lines filled with explosives – however, neither system is designed to operate in the surf zone.

China's Marine Lizard

China's *Global Times* on 14 April 2019 stated:

> China has built the world's first armed amphibious drone boat which military analysts said could be used in land assault operations… the drone ship, named Marine Lizard, successfully passed delivery checks and left factory on April 8 in Wuhan, capital of Central China's Hubei Province…

The article reveals that:

> In ship form, the 12-meter-long Marine Lizard is a trimaran propelled by a diesel-powered hydrojet and can reach a maximum speed of 50 knots while maintaining stealth. When approaching land, the amphibious drone ship can release four continuous track units hidden under its belly, and travel at 20 kilometres an hour on land.

The article explains that Marine Lizard's payloads include an electro-optical system and a radar system as well as two machine guns and a vertical launching system for anti-ship and anti-aircraft missiles. It does not tell how it will dispose of mines and other beach defences.

According to the *Hubei Daily* report a company spokesperson explained that:

> The drone boat is also a great choice for coastal defence… it can remain dormant on an uninhabited island for up to eight months before engaging in combat once it receives orders… Provided with world-class navigation by China's independently developed BeiDou Navigation Satellite System… Having a maximum operation range of 1,200 kilometers, the Marine Lizard can be remotely controlled via satellites.

According to a statement released by Wuchang Shipbuilding Industry Group, the drone is available for export as it is developed with the needs of international clients in mind.

One big question that remains is the actual need for amphibious forces to storm the beaches and to what level. For example the US Marine Corps has not conducted a major amphibious assault since 1950, when it landed at Incheon, Korea, and some commentators say that smaller amphibious raids are not in that same category. However, British, French and Israeli forces have over the years caried out amphibious landings such as in Egypt and the Falkland Islands. The answer is that in a volatile world should the need arise for a landing from the sea then the ships, manpower, equipment and knowledge to undertake that mission will have to be in place. With that goes the need for special forces divers to undertake beach and coastline reconnaissance as well as infiltration for inland missions and of course mine clearance for the foreseeable future.

CHAPTER EIGHTEEN

UNDERSEA SPYING AND SABOTAGE

Land, air and sea battles are generally observed and recorded by the media and they eventually become public knowledge. But with a secretive special forces diver unit the opportunity to keep operations out of the headlines is a valuable tool in a country's military armoury. The ability to undertake reconnaissance or direct action using an unseen force, which might be small in number, can have a devastating impact. Unless the mission goes wrong and somebody is caught then it is all deniable. Countries around the world might allow a brief glimpse into the world of the combat diver but revealing what missions they have undertaken is generally not for discussion. However, some missions do come to light and operatives might speak out, but in very reserved terms and with very few details.

Covert underwater attacks are generally undertaken at night to reduce the chances of being spotted, and to provide a chance of getting away if operatives have to surface. Once a diver is spotted the defence options for the enemy come into play and that can involve explosive devices being dropped into the water, searches by patrol boats or a ship's sonar being turned on. Whichever option is deployed the diver is in trouble and can only attempt to get away as quickly as possible. Some target ships have lights shining down into the water with guards onboard looking for any signs of an attack. If they have sight of a diver they can shoot or drop anti-diver grenades, but people do see things that are not there and peering down to the inky blackness below is not the most gripping way to pass time. Even an ebbing river confuses the situation as jetsam can become the cover for a diver whose head is covered by a box, for example, which is used when close to a target and the diver wants to get their bearings.

Targeting undersea cables and pipelines

Undersea cables and pipelines are not new – on 16 August 1858 Queen Victoria sent a short message in the form of a telegram to the then US president James Buchanan. The message travelled through 2,500 kilometres of newly laid submarine cable, and due to problems deciphering it, took some 16 hours to send, but would have taken ten days to cross the Atlantic

Ukraine Navy sinks Russian landing ship

The small port in the city of Berdyansk lies on the Sea of Azov, a little over 100km west of Mariupol, and was captured by the Russians on 27 February 2022. While greeted with a protest by the local population, who sang the Ukrainian national anthem, the landing was seemingly unopposed militarily, as CCTV footage of the port residential area shows no damage from an attack.

On 24 March 2022 the port was in use with three Russian landing ships at the port; two moored alongside the wharf's cranes on the west side and the third along the end of the wharf. The Allegator-class landing ship, identified as the *Saratov,* had some 55 crew members, and was armed with bombardment rockets, surface-to-air missiles and guns of various calibres. Originally entering service in 1966, it was able to transport between 300 and 425 troops, or 20 tanks, or 40 AFVs, or 1,000 tons of stores. Also present were two Ropucha-class ships, *Caesar Kunikov* and *Novocherkassk*. Commentators express the view that the ships were off-loading stores at the time in support of the Russians' land offensive.

An attack was launched and valuable visual evidence is found from two fixed-location CCTV cameras situated either side of the port area. Facing the port area from the city, the wharf and berthing areas protrude as an oblong out from the land, where cranes and storage tanks are clearly visible through the camera on the western side. There is a stark view showing the two landing ships with the Ropucha-class ship in front of the *Saratov*, which is spewing out thick black smoke with occasional bursts of red-hot explosive flames.

The camera shows some smoke at the stern of the general cargo ship *Rusen Mete* which was moored at the wharf closer to shore and well clear of the Russian warships. There is no evidence from any of the CCTV footage of there being any emergency service vehicles and crews present at the port. Even away from the *Saratov*, the port was devoid of people and vehicles, and it is not known if anybody on the *Saratov* escaped, but the other two ships had crew members on board as they were able to move the vessels away. As the fire and explosions continued on the *Saratov*, the Ropucha-class ship moved away and turned to head out to sea, damaged and partially hidden by dense smoke.

CCTV footage from the eastern camera, which is on the opposite side of the wharf to the damaged ship and further away from the port, shows the scene prior to the attack. There is no indication of anything amiss, then there is a small, barely visible flash, followed by a small column of light-grey smoke, which is carried up and away by the breeze. There is nothing more, until another larger flash, and a darker-grey column of smoke rises into the blue sky. The incident is confined to the far end of the wharf where the Russian vessels are located. A small boat can be seen moving along the east-side of the wharf and heading out to sea before one of the Ropucha-class landing ship moves away, stern-first, before heading out to sea with a

The Russian landing ship *Saratov* was set on fire and sunk by the Ukrainian Navy in occupied Ukrainian territory. Was this a classic special forces combat diver operation with a covert underwater attack? (Photo by Ahmet Dumanl/Anadolu Agency/Getty Images)

fire raging and smoke pouring from its bow section. The *Caesar Kunikov* and *Novocherkassk* continue to make their escape with good speed and steerage, but it is not known how badly damaged either ship is. The western camera then shows a third smaller warship amidst the smoke, following the two landing ships out to sea, but it is not identified and neither camera shows where it came from.

Meanwhile, the *Saratov*, which was still alongside, continued to discharge black smoke with small intermittent fireballs. The western camera shows that there was a fire on the dockside between the cranes and storage tanks, and a Maxar satellite image taken the following day shows that the two large tanks and one smaller tank are still intact and undamaged. The image does show a small fire still burning close to the large storage tanks, which could have been caused by heated debris from the explosions on the Russian ship, but otherwise there is little other damage to the wharf. What is in the storage tanks is not known, but it is likely a combination of waste oil products that are pumped from a ship into the tanks where they are stored until they are transferred either by a small ship or road tanker to a refinery for processing.

The satellite image shows that the *Saratov* had moved a short distance away from the wharf and then settled low in the water or even on the seabed, where it looks like a burnt-out hulk. It is noticeable that the image does not show any vehicles or equipment in the port vicinity, so the fires were allowed to burn themselves out. The western camera scanned the sea and does not show any other warships in the area, but there were three small boats which could be tugs escaping the port by moving along the coastline. There is no evidence that any of the Russian warships engaged other ships/boats with their armaments.

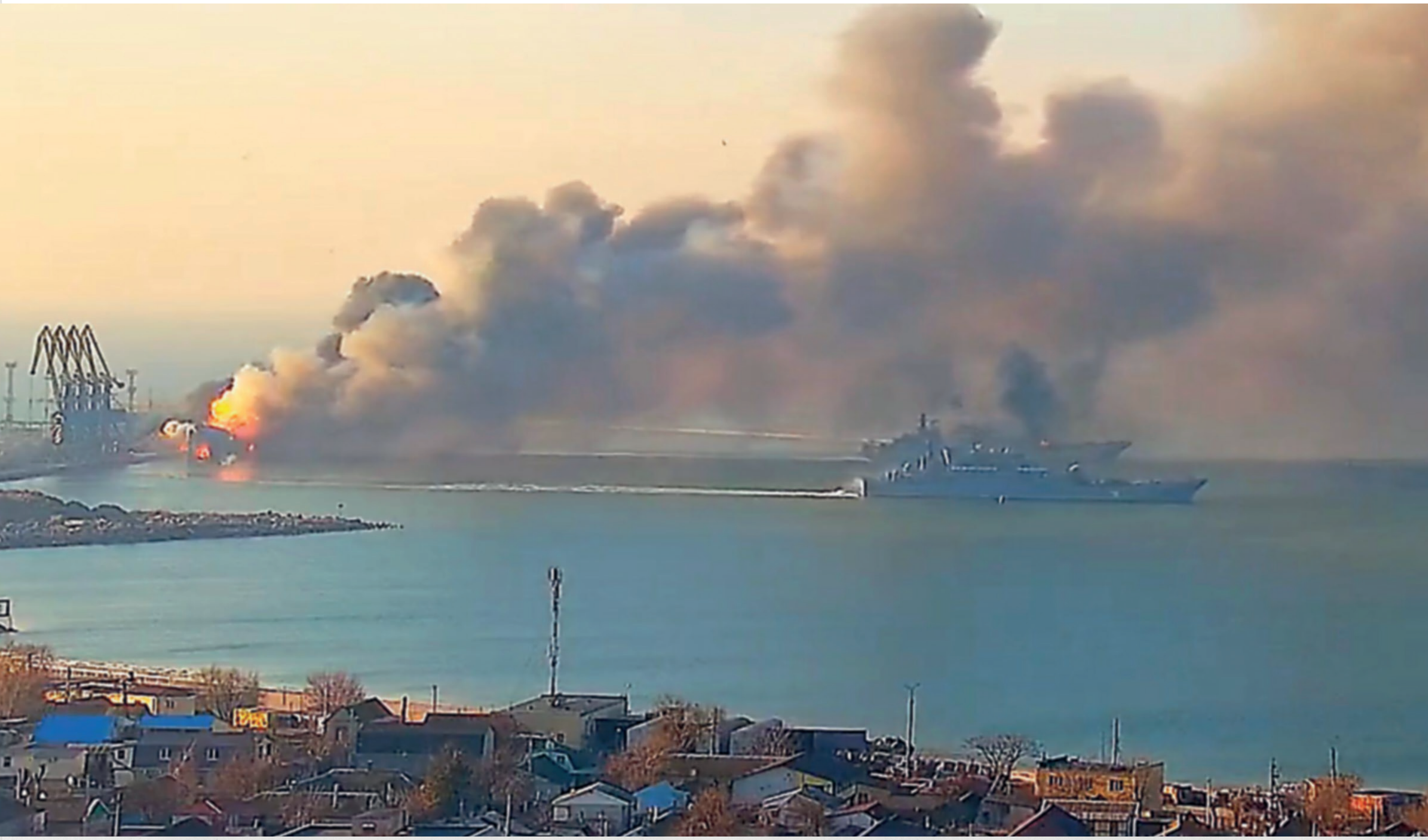
This was a major victory for the Ukrainians, but how did it happen? At the time of writing it is pure speculation, but from reviewing the available evidence it is known that when the Russians invaded and took control of the Crimea in 2014, they captured most of what was the Ukrainian Navy and placed it under Russian control, and that included the only submarine in the fleet.

It was originally thought that a Ukrainian Tochka-U short-range ballistic missile had been used, but it is clear from the satellite image of the port taken the following day that the missile could be ruled out. The Tochka-U was first deployed in 1975 and appears from available data to be unguided, and to have a variable accuracy of 95 to 150 metres so, if used against the landing ship at almost its maximum range, would have required an extraordinary amount of luck to strike the target with no impact damage to the storage tanks or wharf. The missile has a reasonable-sized warhead which, on detonation, would have obliterated the ship and part of the wharf. There would have been a large explosive flash followed by a large cloud of smoke, but the cameras show that this did not happen.

There is no evidence, in the images available at the time and following the attack, of an air strike or any surface naval action, either of which would have created serious damage to the wharf. There is also no evidence of a drone being used, but it cannot be ruled out as the Ukrainian Navy is in possession of some Turkish models. If a drone was used it might have fired some of its weapon load at the other ships moored at the wharf. The attack was quite precise and the small amount of collateral damage could be from the ship's explosive detonations blasting molten steel into the air, as the cameras show. Onshore artillery fire can be ruled out as it would at best have been long-range and observers would have directed fire, which would have required ranging shots be fired to get onto the precise target – and that did not happen.

Some commentators propose that it was the mishandling of ammunition or flammable material that caused a fire, w hich i n t urn caused the first s mall e xplosion t hat w as instrumental in causing a chain reaction of explosives and/or fuel to detonate and explode and burn. It is possible that somebody made a mistake and it all went wrong, but ammunition and fuel is moved regularly and the military have experience of this. Because of the nature of explosives, ammunition and fuel, they are carried in such a way as to ease movement on the supply route which, like the battlefield, a re r ough p laces a nd p rone t o attack.

With their only submarine captured by the Russians in 2014 the Ukrainian special forces are denied any means of long-distance covert underwater operations in what is now Russian-occupied territory, with naval control of the Azov Sea. But combat divers adapt and think outside the box, which the Ukrainians are very good at, so while fighting on numerous fronts with very limited resources, one serious consideration is that it was an underwater attack by Ukrainian combat divers similar to the very first combat frogmen attacks during World War II. Combat divers do not require a lot of equipment, apart from personal basics of diving suits, fins, masks and underwater breathing apparatus plus, of course, the explosive devices. Knowing that the Russians would secure ports along the coastline, which they were desperate to control, the Ukrainians might



The image shows the small port in the occupied Ukrainian city of Berdyansk on the Sea of Azov where three Russian landing ships were berthed. The black smoke at the left of the image shows the aftermath of a Ukrainian naval attack on the *Saratov* with two other landing ships although damaged making good their escape. Was this the result of Ukrainian Special Operations Combat Divers underwater mission? (ZUMA Press, Inc. / Alamy Stock Photo)

have had a plan to sabotage ships that used the ports, thereby having the appropriate resources in place.

Local residents of Berdyansk, being anti-Russian, could have provided up-to-date intelligence, and – bearing in mind that Ukraine has been on a semi-war footing since 2014 – the military would have people on the inside as well as having detailed knowledge of the port. The combat diving team would have been inserted to reach the port area, from where there would be an opportunity to survey the ships and the multitude of entry points to the sea that in the hours of darkness could allow the covert action to commence.

Combat divers are trained to swim long distances on the surface and underwater, and could have easily swum to the moored ships then for the final attack swum underwater to place multiple charges and mines in pre-designated places on the target vessel, before making good their escape back to the egress point from which they would be spirited away to be clear when the first detonation fired. If during the mission any of the divers had equipment problems they would have been able to swim ashore and sneak away without raising the alarm.

At 5am the explosives would have detonated, putting in motion a chain reaction leading to the destruction of the landing ship. The CCTV images from the western camera appear to show flashes of explosives at the waterline, which could be caused by limpet mines, although the preference is to have them underwater as the water-mass pressure helps to push the detonation into the ship. Explosives tend to find the route of least resistance, so that would be upwards away from the water, but the divers would have studied the layout of the landing ship to identify the most vulnerable place in which to place mines and improvised explosive devices. The explosive devices could impact on any fuel storage, which in turn could affect any ammunition stores, resulting in numerous small explosions compared to one very large one – which meets the criteria of what happened.

One twist to the incident is that as the explosives detonate and warships move to escape, the eastern CCTV shows an individual dressed in black in a small green one-person inflatable boat which appears to be powered by a small outboard motor. The person progresses towards the shore, before stopping and removing the outboard, and using oars to row the boat to the shore. There is no indication as to where it has come from as it continues towards the beach, where another person dressed in black awaits. As the boat lands, the person onshore helps pull it up onto the beach and then both of them stand surveying the scene at the end of the wharf before picking up the boat and carrying it stern-down up the beach, to disappear behind some buildings.

We may never know the truth and details of the operation to target and sink the *Saratov* and nor should we, especially if it was a special forces combat diver mission. It takes good intelligence, skilled operators and daring to pull it off and Ukraine's formidable military have shown they possess that in abundance.

by ship. It was the start of a communications revolution and today such cables carry 96 per cent of our communications. Other cables carry power for a wide range of reasons, and in some instances are the sole provider of power to small islands.

It is not just communications and power cables that connect provider to user, but pipelines too are invaluable. Perhaps one of the most famous pipelines was called PLUTO, Pipeline Under the Ocean, which was used during World War II. It was designed and installed to supply fuel from storage tanks in southern England to the Allied armies in France, which enabled the advance against the enemy to continue. In a secret operation it was manufactured and floated into position across the Channel, where it allowed the fuel to flow unseen to support the landings. There followed submarine pipelines being installed at the bottom of the English Channel connecting Britain and Normandy, and the Isle of Wight and Querqueville, west of Cherbourg.

Offshore exploration for gas in the southern sector of the North Sea required underwater pipelines to carry the gas from the structures at sea to an

onshore terminal. The pipelines onshore and across the beach and out in the shallow waters were buried, but in deeper water the pipes were just laid on the seabed. The exposed part, which was in fact most of it, was inspected by divers who swam the length in relays and reported any anomalies, unlike today where remote-operated vehicles do the job. This required a boat carrying a team of divers to set up over where the pipeline should be, then a diver would descend down a weighted rope to the seabed and do circular searches until the pipe was located. The rope would then be secured to the exposed pipeline and a red plastic buoy attached at the surface. Divers would then take turns to dive down and swim along the pipe, towing a line with a small buoy on the surface. The diver would look for any damage which could have been caused by a boat's anchor, or any object that should not be there – there were occasions when sea mines were snagged onto the pipe, which was a job for RN clearance divers. Scour was a major issue which left the pipelines exposed above the seabed and at risk of damage, so the hole would have to be filled with sandbags. I spent many hours underwater on those pipelines, and later there were reports circulating that crawler tracks had been identified on the seabed close to pipelines, but I never saw them. The underwater pipelines have always been at risk and remain so today as they carry oil and gas from offshore fields to land, not only in the UK, but all over the world. Mini-subs could attach explosives to cut them and deny the vital resources reaching land.

On 28 August 1986 I was at the harbour of Peterhead on the Scottish east coast, where I was seeking evidence of Soviet special forces activity within the UK for a book, *Operation Spetsnaz*, which was published in 1989. Spetsnaz divers and mini-subs were already targeting Sweden, and there were reports that there were incursions into other countries. One such intrusion had been reported at a US Navy base in Subic Bay in the Philippines, on the other side of the world. Although the US Navy has not released any details, it has denied suggestions that the intruders were Philippine insurgents because of the sophistication of the equipment and the professionalism of the operatives. The operations had been so successful that the Soviets expanded their mini-sub activity into other parts of the world. Tracks of mini-subs were found off Gibraltar and near Japanese naval bases.

Spetsnaz also appeared to be flexing its muscles in Alaska. On 12 February 1988, Dean Fosdick of Associated Press reported that: 'Soviet commandos may be staging covert landings on a United States island in the Bering Sea… An increasing number of reports of unidentified aircraft, submarines, swimmers in scuba gear and discarded military equipment are being made to US intelligence agencies.'

But on that day in Peterhead in 1986 large Soviet fishing factory ships were moored in the harbour confines. For the people of the port they were welcome visitors, bringing extra trade to both local fishermen and to the shops in the town. One vessel, the *Sovetskya Latvia*, was moored against the northern

breakwater and could be examined more closely than the other vessels. The *Sovetskya Latvia* was around 16,000 tons in displacement, carried a crew complement of around 260 and boasted a cinema, sauna, and helipad, which could be used for games of football or volleyball. In common with all the other such ships it was fairly old – its grey hull and dirty white upperworks faded and weathered. Such ships were away from their home ports for half of each year, and maintaining appearances was a low priority. The vessel had two holds, divided by a central superstructure housing the bridge, and surmounted by the helipad, which was shrouded by a net. Under observation for four days I did spot a team of what could only have been military operatives emerge to exercise on the deck. They were partially obscured by lifeboats but once they realized they had been spotted they immediately returned below deck.

Further observation and intelligence reports concluded that they would have been Spetsnaz operatives. I knew that large fishing factory ships that I had observed were capable of carrying and deploying mini-submarines, such as

The *USS Jimmy Carter*, the extended secret and special ops submarine. (US Navy photo by Lt Cmdr Michael Smith/Released)

those that had been deployed in Sweden. Russian special forces divers and their underwater vehicles could operate around the world hiding behind what would be deemed merchant ships. The only thing that has changed in the intervening years is that the Russians have advanced in technology in underwater operations, but the modus operandi remains the same – covert and silent warfare.

Are the pipelines and cables really that important? In the case of cables the fact is that our everyday lives are now totally dependent on electronic devices for communication, industry, transportation, shopping, banking and indeed virtually every aspect of ordinary life. CNN reported that in 2019 there were around 380 underwater cables in operation around the world, spanning a length of over 1.2 million kilometres, and that will only increase. It requires little imagination to see that special forces divers and specially trained deep sea combat divers could have a devastating impact on a country that relies on undersea communications cables and pipelines – which is most of us.

Undersea fibre-optic cables are sheathed in a thick steel husk and buried in a deep trench until they reach deeper water where they are usually left to lie uncovered along the ocean floor. They are at risk from fishing boat trawls, ships' anchors and sabotage. Onshore the cables can be buried and guarded, but out to sea they are vulnerable. This is not a new threat, it has been around for many years, although technology has made a dramatic difference with the volume of data involved, and the ability of aggressors to locate and take action on cables.

At the height of the Cold War Soviet submarine activity was detected in Sweden and off the Norwegian coast (see Chapter 5), and their midget submarine tracks were found in Japan's Soya and Tsugaru Straits in August 1984, as well as in the vicinity of offshore oil rigs in the North Sea. Covert diving operations would have occurred simultaneously.

But the US Navy was similarly active. In the early 1970s the US government learned that an undersea cable ran parallel to the Kuril Islands off the eastern coast of Russia, providing a vital communications link between two major Soviet naval bases. At the same time the Soviet Navy had denied access to

TOP RIGHT
The *Yantar* research vessel, one of many that roam the oceans and seas of the world. Note the heavy lift cranes and frames for launching mini-subs over the stern or side. The craft carries an array of communication arials and electronic surveillance systems for spying. (Mil.ru , CC BY 4.0, https://creativecommons.org/licenses/by/4.0/deed.en)

BOTTOM RIGHT
A good view of a Russian deep submergence vehicle. The craft is fitted with a skirt that allows it to mate up with the hatch of a larger submarine where it can transfer people at depth. It is fitted with robotic arms for work purposes, propulsion systems to aid manoeuvrability and underwater CCTV. (Russian Federation Ministry of Defence)

foreign ships from entering the area. The response was for the US National Security Agency to activate a covert operation codenamed *Ivy Bells*, which required deploying fast-attack submarines carrying combat divers to place waterproof recording pods on the lines. That required the divers to be deployed every few weeks to recover the recordings for the National Security Agency (NSA), who in turn would dissect the information. However, the project came to an untimely end when NSA employee Ronald Pelton sold information about the programme to the KGB for $35,000.

In more recent times the submarine USS *Jimmy Carter* (commissioned in 2005) was modified for testing new submarine systems and classified missions when its hull was extended 30m to create a 2,500-ton supplementary middle section which forms a Multi-Mission Platform (MMP). This section is fitted with an ocean interface for divers (a diver lock-out system which allows for decompression requirements) and unspecified special operations equipment, such as an ROV and handling system. There is storage and deployment space for mission systems, including space for a considerable length of fibre-optic cable. There is a pressure-resistant passage between the fore and aft parts of the submarine to accommodate the crew's movement throughout the entire vessel. The submarine has additional manoeuvring thrusters fitted fore and aft that allow it to keep station over selected targets with a system called dynamic positioning. Computers linked to sensors control the thrusters to keep the sub on a fixed station. This is very useful in shallower waters where currents can affect the movement of the boat. In addition to undertaking cable taps the boat is able to carry out a number of specialist missions, from deploying 50 commandos to deploying and retrieving unmanned and autonomous undersea vehicles.

The USS *Jimmy Carter* was the only submarine of its class built and had a capability to tap undersea cables. The 45-foot extension added to the submarine provided a facility to allow engineers to lift the cable up into a floodable chamber to install a tap. However, commentators claim that it is unlikely that the submarine routinely taps cables because the US intelligence agencies can more easily obtain data through cable taps above-ground.

Where the submarine is the option of choice, the craft has to position itself over the cable and remain on station while a length of cable is lifted inside a work chamber to allow the technicians to work on it. The task is fraught with risk because any slack from the laying of the cable would allow for the lifting, otherwise, without that flexibility, there would be undue strain on the cable. While open to the sea the chamber would have to be kept dry and the operators would be under saturation diving conditions. Another option would be for the sub to have an underwater habitat which it could lower onto the seabed to sit astride the cable. The sub would remain attached to the habitat as it supplies the services to maintain life and a dry environment. In any event the technicians would be dealing with high voltage – not an ideal situation.

The US is not the only power in the underwater cables spy war, and in 2015 US intelligence officials said underwater sensors had identified Russian submarines near key communication cables, along with a spy ship believed to carry small underwater vehicles designed to sever or damage cables. The Russians have all manner of vessels, from fishing boats to merchant ships, that can be, or are, adapted to transport, launch and recover mini-submarines, ROVs or autonomous undersea craft which are equipped to be able to use manipulators to move objects on the seabed. They may also position sensitive communications equipment so as to intercept undersea cables or damage them to cut communications.

Reports in the media have multiplied in the United States and Europe that Russia has intensified its submarine activity around the undersea cables which are essential for the global operation of the internet. The Russian submarines, under the direction of the Russian Navy's Directorate of Deep Sea Research (GUGI), are active, but there is no public indication as to exactly what they are doing and why. Russian media have made claims that Russia has the capability to hack into the underwater cables. They also claim that Russia has an increasing number of special-operations mini-submarines deployed to facilitate its clandestine cable activities.

The *Yantar* is officially classed as an oceanographic research vessel, but like its predecessors it has an array of surveillance equipment, and is a mothership for manned and unmanned deep-sea submersibles. The *Yantar* has a displacement of 5,200 tons and is 108.1m long by 17.2m wide, and was delivered in May 2015.

The vessel is equipped with two three-person-deep submergence submarines for a number of undersea missions, which could include cable cutting, laying of taps on undersea cables, removing other countries' taps, and other related intelligence operations, or for recovery of sensitive equipment from crashed aircraft, test missiles or other underwater equipment.

The deep water submersibles are, according to some commentators, able to operate at depths of up to 6,000 metres which means that they would not be equipped to allow divers to work from them. They would rely on their robotic arms to carry out any handling functions.

On a ship like this there is always the option to carry other underwater craft, so it might carry diver mini-subs to allow covert operations, and it could be expected that this type of vessel could be fitted with a saturation diving system.

In January 2018 the BBC raised concerns about the *Yantar*'s activities which caused concern with the UK military that Russia could interfere with, or even cut, crucial undersea communications cables.

The Royal Navy has responded with a new Multi-Role Ocean Surveillance ship which will be fitted with advanced sensors and will carry a number of remotely operated and autonomous undersea drones which will collect data. The vessel, staffed by 15 people and due to come into service in 2024, will carry out operations in both UK and international waters.

Under Putin, a rundown submarine fleet has seen a partial rejuvenation. However, there have been some disasters. In 2019 a fire aboard the special operations submarine *Losharik* resulted in the deaths of 14 submariners just 100km off the coast of Norway, reportedly including some of the most experienced and decorated officers in the Russian Navy.

The *Losharik* was constructed with seven operational titanium spheres with the front five interconnected, while the last two paired up which held a nuclear propulsion unit. From information available from numerous commentators it is estimated that the length of the sub was 60m, with a 7m beam which would be the outer shield that streamlines the spheres. Having worked in saturation diving using a system with spherical chambers, the shape is not conducive to good working and equipment space, but that is the trade-off for a vessel built to dive deep and endure the external pressure. The commentators conclude that the smaller subs are carried underneath a large mothership – a Delta IV-class submarine – and would have to be secured in place for transit. With the two subs mated up it would allow the crew to transfer between them while at depth. The sub carries no armaments, but has robotic arms with which to carry out a wide range of tasks, including lifting or cutting seabed cables.

The only witnesses apart from the crew of both submarines, who remain silent, are some Russian fishermen who were out in a small boat when a submarine broke the surface in front of them. The submarine was not the *Losharik* but a much larger vessel – the mothership. They reported that the submarine moved away at speed.

From the information available, some of the *Losharik*'s crew clearly survived by transferring to the mothership, which means that the vessel was connected at the time and the mothership surfaced to be ready to evacuate if required.

Commentators believe that Russia has six submarines dedicated to the cable-cutting mission – with the *Losharik* the most modern and capable.

The world of underwater warfare is setting new challenges for the defence of communications, power and pipelines. The threat can come from combat divers carried to the target area by mini-sub or SDV, who could simply place explosive charges and then depart the area unseen. On land there is always the risk of getting caught and exposed. The ability to make repairs in shallower waters might be less problematical than in the deep ocean where the cable would have to be raised to the surface and then laid back down – it might well be more cost effective to lay a new cable, but whichever option is selected the cable will be out of action for a considerable period of time. In shallow water an ROV can follow the cable or pipe until the damage is located, but in deeper water the process is much slower. The problem for the countries affected is identifying who did it, with a large submarine launching a smaller deep-diving sub, a mini-sub or SDV to do the deed, where they could then slip away – unless caught in the act – leaving mayhem behind them.

CHAPTER NINETEEN

THE FUTURE

The reader has had a glimpse into the world of the elite underwater warrior, who belongs to a long line of forebears and now include women among their ranks. I had wanted to close with a chapter on the future, but the reality is that the modern world of the combat diver, their equipment and underwater craft, is one of secrecy. In the gathering of information I experienced a reluctance in many quarters from defence ministries, operational units, and the designers and manufacturers of underwater vehicles and equipment – a very guarded reluctance to share a vision of what lay ahead. Ideas come and go; some are successful and some are assigned to history.

To partly answer the question of what challenges the future holds for the combat diver I draw on a view of the Dutch Marine Corps, which is taken from a Corps historical record titled *Qua Patet Orbis: The Netherland Marine Corps in an age of conflict*, published by the Netherlands Ministry of Defence. Under a sub-heading – 'Games consoles and emergency rations' – the Dutch provide an interesting insight:

> In the years after 1989, the Netherlands Marine Corps faced a paradox: could new generations actually handle the challenges of modern military deployment? While the Dutch sea soldiers had a clear impression that the general level of fitness and commitment of recruits was falling, the bar was set ever higher. The skill sets of the Marines grew ever more extensive and complex. The world was a different place. The Netherlands armed forces were given a new expeditionary task in complex operational environments. The threat of Soviet divisions gave way to hostile peace spoilers and violent, irregular, often invisible and always unpredictable opponents. In the distant past, the Dutch Marines had already been sporadically involved in counter-guerrilla and counter-insurgency operations; now these missions became the rule, rather than the exception.
>
> From the early 1990s onwards, working as a Marine therefore demanded greater perseverance and adaptability in order to face up to the different challenges and opponents. Whether these were the troops of Saddam Hussein in Northern Iraq or the elusive Khmer Rouge in Cambodia at the start of the 1990s, or the armed groups and Taliban resistance fighters in Afghanistan, Somali pirates or Muslim extremists

and Tuareg rebels in Mali: the world was becoming less clear-cut, security challenges greyer and missions more complex. This was in sharp contrast to the influx of young recruits having grown up in prosperity, surrounded by entertainment and video games, who seemed barely to have left their living room couches throughout their youth. Put another way, the ‘delta’ between games consoles and emergency rations was becoming ever wider.

One of the major challenges facing the Netherlands Marine Corps was how to deal with this situation: lowering values would weaken the unit. But the same applied when raising the bar: could the training centre then still supply enough suitable Marines? Until recently, the Marine Corps seemed able to avoid this dilemma by continuously adapting the training programmes and modernizing the advanced training for operational units. Recruits joined a corps which in terms of size and outlook had changed little since the end of the Cold War. Their new job still brought with it prestige and pride. Nonetheless, older colleagues were heard to complain that today’s Marines were no longer the fire eaters of their youth. ‘We would be happy with ten A-grades, but today we have to make do with twenty C-grades’, commented one of the trainers in 2012. A daily newspaper quoted one Defence spokesman in that same year who euphemistically pointed out: ‘We are forced to accept the need to further train graduates in actual practice.’

Complaining about recruits, however, has also been one of the constants in Marine Corps history. In 1990, Major Axel van Willigenburg, who taught tactics at the Royal Naval College, referred to the group of candidates from the prosperous years of the 1970s and 1980s in which individualism and a ‘pampered’ society set the tone. Even then there was the perception that it was difficult to find the ideal Marine candidates. However, there was no evidence that the strength of the Netherlands Marine Corps was being negatively affected. Physical strength, perseverance and flexibility remained requirements within the organization. Since the end of the Cold War, new life had been breathed into an old call of duty: expeditionary deployment. Modern Marines flew and sailed all over the world. They returned home veterans with plenty of combat experience. The ‘pampered’ generation to which Major Van Willigenburg had referred in 1990 became an operational and expeditionary generation that faced tough challenges in the Middle East, in Cambodia, in the Balkans, in sub-Saharan Africa, in the Caribbean, in Afghanistan, on the Mediterranean Sea and in the Indian Ocean off the coast of Somalia. It became a generation that was justified in claiming the motto ‘Qua Patet Orbis’ – As far as the world extends.

The combat diver is equipped with the latest technology: the Stealth CDLSE. (JFD Marine)

As the modern world evolves and attitudes change, history has shown that there is never a shortage of warriors who aspire to be an elite, and for many there is the ultimate challenge of being a combat diver.

While technology and machines may take over many roles, there will for the foreseeable future always be a need to have a human in the water. The future of combat diver transport is supported by a range of companies who focus on designs that meet the end user's requirements and budgets. It might well be a case of more underwater craft means more divers, allowing more flexibility of operations.

For an informed vision about the future direction of travel for defence diving I turned to Paul Haynes, who is a former UK Special Forces Special Boat Service combatant diving instructor, diving supervisor, and SDV pilot and navigator. Author of numerous specialist free-flooding submersible and multi-role rebreather studies on behalf of the UK MOD, Paul remains at the forefront of maritime special operations, underwater life support systems and Tactical Diving Vehicle design, evaluation and operational application. He is an independent defence diving consultant at Haynes Marine Ltd, which also represents JFD, the world's largest manufacturer of defence and occupational diving equipment. He explains that:

> All areas of the military require to evolve in order to meet current and future threats. Defence diving is no exception and notable changes are currently taking place in response to changing doctrine and concepts of operations. The recovery of a sunken river bridging system or battle damage repairs at sea cannot yet be fully accomplished by machine alone. As a consequence, the requirement for a manned intervention

> underwater engineering capability by both Armies and Navies will remain for the foreseeable future. However, in the field of naval Mine Countermeasures (MCM) diving, significant effort is being made to remove the 'man' from the minefield by substituting the human with a Remote Operated Vehicle (ROV) or Autonomous Underwater Vehicle (AUV). As a consequence, the number of specialist MCM divers is predicted to decline and manned MCM 'clearance diving' will in the main, likely be restricted in the future to very shallow water where wave action can preclude ROV/AUV use.*

Paul confirms the situation faced by special forces divers in that:

> With a focus on land operations for the last two decades, maintaining and developing a Special Operations diving capability has not been the priority of most Western nations. However, the current geopolitical landscape has initiated a maritime pivot by NATO and her allies, all of whom are currently re-structuring their defence forces accordingly. Both 'blue water' and littoral maritime activity will therefore likely increase globally, which will inevitably include the expansion of maritime Special Operations Forces (SOF) activity.

The expansion of combat diver units around the world will have increased the knowledge of their capabilities and so have added to the ability to develop effective defences, and Paul explains that:

> The viability of inserting a Tactical Diving team by small inflatable craft to within realistically achievable swimming distances of an objective is rapidly declining as a consequence of sophisticated land, sea and airborne sensor/weapon systems that are able to reach deep into the littoral zone. In response to this threat, surface or sub-surface SOF support vessels will require to remain further offshore in the future. Crossing the increasingly expanding 'water gap' discretely and covertly is therefore presenting an increasing number of challenges to maritime SOF planners.

He further explains that the answer will be:

> To extend the sub-surface range of a Tactical Diver, increasing use of the Tactical Diving Vehicle (TDV) is being made. Whilst such means of transportation is not new, miniaturized precision navigation systems and rapidly evolving high-power density battery technology is enabling

* Interview with author.

> increased TDV duration whilst reducing submersible weight and size. In addition, there is a trend towards larger multi-man TDVs that can travel long distances on the surface at high speed and when the threat level requires, fully submerge for a covert insertion/extraction or for threat evasion. Such craft are increasing in sophistication providing the ability to not only transport maritime SOF, but to act as surveillance, reconnaissance, target acquisition and stand-off attack platforms, greatly enhancing maritime SOF capability.

That said, there is a downside that has to be addressed. Indeed, as Paul states:

> The limitation of the current generation of TDVs is that they are free-flooding and as a consequence, both the maritime SOF Operator and their operational 'field' equipment are submerged for long periods. This can have a significant detrimental impact to human performance and equipment reliability. Therefore, to both mitigate the negative effects of extended submergence and to extend operational range, there is a trend towards the use of one atmosphere TDVs where personnel are transported in the dry. Once at the objective area, the one atmosphere capsule is partially flooded and pressure equalized to enable personnel to lock in and out of the vehicle sub-surface.

While future developments are in the classified secret box there is some indication from Paul, albeit vague, about the way ahead:

> As the complexity of Tactical Diving missions evolve, the need for increasingly sophisticated ancillary diving systems becomes necessary to support such missions. The days of a 'combat frogman' carrying little more than a 'limpet mine' and a knife are in the distant past. Tactical Diving life support systems are increasingly required to form an integrated element of the SOF operators' war-fighting equipment. As a result, it is becoming increasingly important to interface the life support system with other critical operational equipment to enable the Tactical Diver to move efficiently and effectively between the diving and land phase of an operation. Significant design effort therefore has and continues to be applied to the development of specialist high-performance ancillary diving equipment to help facilitate Tactical Diving operations. Dependent upon the operation, today's Tactical Diver may be wearing an advanced 'breathable' fabric drysuit in conjunction with a personal propulsion system. Worn over the drysuit may be a climbing safety harness and an ergonomically tailored equipment load carry ballistic protection system to enable for example the stowage of ammunition, personal radios, field knife, demolitions

> equipment, tactical lights, respirator and emergency location tactical beacon and strobe. Clipped onto this load carry harness will then be the operation specific life support system and a buoyancy control device. Personal weapons could consist of an assault rifle together with a side arm. In addition, a shotgun with solid lead projectile ammunition for breaching operations may be carried. For ballistic protection during any land phase, the Tactical Diver may be wearing a highly advanced composite material ballistic protection helmet and worn on the torso, ceramic plates that protect vital organs from high velocity projectiles such as small arms weapons.

Paul emphasizes the future focus for the combat diver is in the equipment, such as communications and navigation, a particular requirement for those on covert operations, and he concludes with that message:

> The ability to transmit communications sub-surface between Tactical Diving teams is increasingly required. Through-water communications systems enable voice and data transmission over distances exceeding 5,000 metres. However, such systems provide a non-secure detectable signal and are not always appropriate when operating against technologically advanced adversaries. Providing encrypted through-water communications is therefore under development with a number of systems offering the potential of secure diver communications.
>
> The 'swim board' remains the fundamental means by which the Tactical Diver navigates sub-surface. Using a simple analogue magnetic compass, depth gauge and watch, such systems are robust and easy to use. However, electronic navigation aids offer a broader situational awareness picture and a precise means of navigation using miniaturized systems such as inertial navigation, doppler, satellite navigation and chart plotter, forward-looking sonar, all built into an electronic diver navigation system. Such systems can be mounted in a TDV and where required, may be removed to provide a means of navigation for the free-swimming phase of the operation. In addition, miniature digital electronic compass and depth metre can be incorporated into a peripheral vision display mounted on the diver's mask providing a 'heads' up' display of compass heading, depth and time.

As a former SBS diving instructor, Paul Haynes has provided an insightful glimpse into the present and future role of combat divers. It is clear that as we move into the future, the role of the combat diver to undertake covert operations will continue to be vital, and the evidence shows that countries are continuing to develop their underwater special operations capabilities.

Yet, the final words of this chapter must go to T.J. Waldron and James Gleeson, two World War II frogmen, and, indeed, their words still ring true all these decades later:

> During the last war, courage was a fairly common quality. One saw it, heard about it, or read about it in the general public, the Civil Defence Services, the Armed Forces, and last, but by no means least, in the Special Services, and the Secret Service. It may be that there was more need for courage than ever before; certainly methods of warfare more devastating than ever before had been invented and used. Also other methods, more individual and more personal, were put into action. These methods called for the highest possible qualities of courage and self-sacrifice in the men whose business it became to operate them.
>
> This is the story of the brave men who worked alone, under the water. Some wore fantastic-looking rubber suits with great webbed feet, some walked, or crawled on the muddy bottoms of harbours in complete darkness, looking for mines, some bestrode torpedoes – 'the Charioteers' they were called, some slipped through the black waters in midget submarines. They worked alone, in the dark, in enemy waters. When they started on a mission they knew that the chances were that they had taken a one-way ticket, that there might be no return. That grim knowledge went with them deep down in hostile waters. But it was a forgotten knowledge, stored on one side, completely subjugated to thoughts of 'attack,' and their determination to cripple the enemy, no matter what the hazards or the cost.*

Today, many years on, men and women around the world continue to uphold that standing as elite underwater warriors.

* T.J. Waldron and James Gleeson, *The Frogman*, Morrison and Gibb, London (1950)

FURTHER READING AND BIBLIOGRAPHY

Belton, Catherine, *Putin's People: How the KGB Took Back Russia and Then Took on the West*, William Collins, London (2020)

Boyd, Derek, *The Royal Engineer*, Leo Cooper Ltd, London (1975)

Carncell, Don, *Black Water: By Strength and by Guile*, Virgin Books, London (2001)

Couch, Dick and Doyle, William, *Navy SEALs: Their Untold Story*, William Morrow and Company, New York (2014)

Davis, R.H., *Deep Diving and Submarine Operations*, The Saint Catherine Press Ltd, London (1935)

Falconer, Duncan, *First into Action: Dramatic Personal Account of Life in the SBS*, Little, Brown & Co., London (1998)

Hampshire, A. Cecil, *The Secret Navies*, William Kimber, London (1978).

Katz, Samuel M., *Illustrated Guide to the World's Top Naval Special Warfare Units*, Concord Publications, Hong Kong (1999)

Konstam, Angus, with Edouard A. Groult and Adam Tooby (illustrators), *Tirpitz in Norway: X-craft Midget Submarines Raid the Fjords, Operation Source 1943*, Osprey Publishing, Oxford, UK (2019)

Ladd, James D., *The Special Boat Squadron*, Arms and Armour Press, London (1983)

Lyman, Robert, *The Real X-Men: The Heroic Story of the Underwater War 1942–1945,* Quercus, London (2015)

Parker, John, *SBS: The Inside Story*, Headline Book Publishing, London (1997)

Pugh, Marshall, *Commander Crabb*, Macmillan, London (1956)

Royal Engineers, *The Royal Engineer Journal*, Royal School of Military Engineering

Schofield, William and P.J. Carisella, *Frogmen First Battles*, Branden Publishing Co., Boston (1987)

Sutton, H.I., *Covert Shores*, self-published (May 2016)

Waldron, T.J. and James Gleeson, *The Frogman*, Morrison and Gibb, London (1950)

Waldron, T.J. and James Gleeson, *Naval Frogmen: Wartime Underwater Operators*, Fonthill Media, London (2014)

Webb, Brandon, *Making of a Navy SEAL: My Story of Surviving the Toughest Challenge*, St Martin's Press, New York (2015)

Welham, Michael, *Combat Frogmen*, Patrick Stephens, Yeovil (1989)

Welham, Michael, *Naval Elite Units*, Arms and Armour Press (1990)

Welham, Michael, *Exploring the Deep*, Patrick Stephens, Yeovil (1994)

ABOVE
The Vernon Mine Warfare & Diving Monument, Portsmouth, UK. (Rob Hoole)

RIGHT
The entrance to The Diving Museum – Portsmouth. (Author's Collection)

Welham, Michael, *Kampfschwimmer. Geschichte, Ausrüstung, Einsätze*, Motorbuch Verlag Stuttgart, Stuttgart (1996)

Welham, Michael and Bruce Quarrie, *Operation Spetsnaz*, Patrick Stephens, Yeovil (1989)

Welham, Michael and Jacqui Welham, *Frogman Spy: Britain's 100-year Spy Secret*, W.H. Allen, London (1990)

Welham, Michael and Jacqui Welham, *Crabb and the Grey Rabbit: Britain's 100-year Frogman Spy Secret*, Welham Books, London (2017)

Willink, Jocko and Leif Babin, *Extreme Ownership: How the US Navy SEALs Lead and Win*, St Martin's Press, New York (2015)

Wood, Forrest G., *Marine Mammals and Man: The Navy's Porpoises and Sea Lions*, Robert B. Luce Inc., Washington (1973)

Young, Darryl, *SEALs, UDT, Frogmen: Men under Pressure*, Ivy Books, California (1994)

Combat Diver Image 253

The US Combat Diver Foundation logo. (Author's Collection)

Combat Diver Image 254

The US Navy SEAL Team 3 badge. (Author's Collection)

ABOVE
The US Combat Diver Foundation Museum uses the badge shown at the CD dive training centre. (US Department of Defense, photo by Robert Lindee)

FAR LEFT
The US Combat Diver Foundation logo. (Author's Collection)

LEFT
A patch from the US Navy SEAL Museum. (Author's Collection)

ABOUT THE AUTHOR

Michael G. Welham is the author of *Combat Frogmen*; *Naval Elite Units*; *Exploring the Deep*; and *Frogman Spy*. He has been involved with diving, both military and civilian, for some 40 years, and was a Royal Marines Commando, with skills in diving, canoeing, and parachuting; a member of 21 SAS Rgt (R); and a member of 95 Commando Naval Gunfire Support RA (R). Welham was both an air and saturation diver for commercial diving companies, and a diving supervisor and superintendent working in the North Sea, Norway, the Netherlands, Brazil, Nigeria, the Middle East and other overseas locations. He worked in an oil company's diving department, involved in subsea projects, which was followed by a short period as a diving consultant in the Netherlands, before spending 15 years as a UK government diving officer.

INDEX

Page numbers in **bold** refer to illustrations and their captions.

Achille Lauro 200
adaptability 286–287
Aden, Gulf of 204, 206–207, **207**
Admiralty Diving Committee 24, 26
Admiralty Experimental Diving Unit 24–25, **24**
Afghanistan 85, 96, 97, 101, 125, 235
Agrupación Buzos Tácticos 92, **92**
air compressors 13
aircraft 190, **190**
Al Qaeda 202
Alexandria 19
Amphibian Mark 1 breathing system 14, **15**
amphibious assault 272
Amphibious Landing Platforms 237
Argentine Navy 92, **92**
ASDIC 37
Assault Breacher Vehicle 271
Australia
  Clearance Diving Team 78–79, 103, **104**, 105–108, **106**, **107**, 174–175, **174**, **212**
  commandos 103, **104**, 105–108, **106**, 175
  SASR 116
  submarines **186**
Australian Defence Force 108
Australian Defence Force Diving School 175
Autonomous Underwater Vehicles 267–269, **269**, 289
  CRABs 271
  crawler amphibious systems 269–270, **270**
  Marine Lizard 271–272

Bangladesh Forces 130
Barham, Able Seaman Diver Phil **114**
beach clearance operations 38–39, **40**, 41–43, **212**, 213–214, **214**, 271
beach reconnaissance 44, **47**, 216, 244, 265–266, **270**
Beckford, Martin 203–204
Belgian Special Forces Group 167
Belloni, Angelo 22
beluga whales 263
Black Sea 135
boarding operations **104**, 123, 125
bomb disposal 117, 212
Bonnin, Master Chief Mary 148
Boom Defence Boat 30, 32
Bordeaux raid 28–29, **30–31**
Bosnia 97
Bowden, Mark 79–80
Brewster, Sub Lieutenant 35
British Army, Royal Engineers **115**
British Naval Headquarters 22
Britton, Sub Lieutenant Tahlia 154, **154**
Brown, Able Seaman 35
Brown, Able Seaman Justin James 78–79

cables and pipelines, targeting 273, 278–285
caisson divers 113–114, **187**, 189, 219
canoes 11, 25, **27**, 28–29, **110**, 122, **126**, 185, **185**, 188
chariots 13–14, 20–21, **21**, 33–35, **33**, 46
  seating 33
  tactics 34
  Tirpitz raid 34–35
  warheads 33
Cherbourg 42–43
Cheyenne Mountain Complex 95–96
China 271–272
Chittagong 130

clearance divers, Royal Navy 112, **112**, **113**, 117
Clearance Diving Team, Australia 78–79, 103, **104**, 105–108, **106**, **107**, **174**, **212**
Clogstoun-Willmott, Commander Nigel 39
Closed-Cycle Energy Source (CCES) powered craft 235
CNN 279–281
Coastal Rangers, Sweden 55, **55**, **66**, 67–70, **68**, **69**
Cobham Mission Systems 245, 248
Cold War 136, 234
Combat Diver Foundation 79
Combat Service Support Group, The Philippines 144–145
Combined Operations Pilotage Parties 38–39, **40**, 41–43, 45
Commandos Marine, France 117, **118–119**, 120–121, **120**, **121**
communications 13, 248–249
Corsica 122
counter-narcotic operations 180–181
counter-terrorism 101, **104**, 112, 125, 147, 199–204
covert underwater attacks 273
  Saratov attack 274–278, **275**, **277**
  targeting cables and pipelines 273, 278–285
Crabb, Lionel Kenneth Philip 17–18, **17**, 21–23
CRABs 271
Craig, Sergeant 35
crawler amphibious systems 269–270, **270**
creatures 45
Crimea 132, 135
Critical Solutions International 269–270
currents 249

Dagens Nyheter 64
Davis Submerged Escape Apparatus 16, 18, **18**
D-Day 38–39, **40**, 41–43, 44
decompression chambers **162**
Deep-Discharge Lead-Acid Battery-powered vehicle 235
Denmark 65
  female divers 152–153, **153**
  Frømandskorpset 123, **124**, 125, 152, **165**, **212**
  Jægerkorpset 125, **125**
  submarines **185**
depth pressures 24
Desert Storm, Operation 223
diving suits 26–27, **26**, 45, **113**, 126, 242, **243**, 244
Dolphin unit, USSR 136–137
dolphins 258–259, 259–260, **260**, 261, 262, 263
Donetsk 132, 135
Dry Combat Submersible 225
dry deck shelters 217–221, **218**, **219**, **220**, **221**, **222**, 223
DSG Technology 254–255
Dutch Marines Special Forces 78

East Timor mission 78–79
environment 11, **12**
equipment 11, 13, 13–14, 15, **15**, 16, 18, **38**, **94**, **107**, **205**
  ballistic protection 244
  breathing apparatus 14, **15**, **16**, 69, **88–90**, 126, **128**, **139**, **141**, **144**, 146, **147**, **179**, 242, **242**, 245–248, **246**, **247**, **248**
  Clearance Divers' Life Support Equipment 114
  climbing safety harness 244
  closed-circuit breathing system **138**
  communications 248–249
  Diver Propulsion Devices **99**, **100**, 102, 126
  Diver Propulsion Vehicles 147
  diving suits 26–27, **26**, 45, **113**, 126, 242, **243**, 244
  failure 193
  fins 27–28
  future developments 290–291
  helmets **113**, **149**
  jetboots 249–250, **250**
  Limpet Mine Disposal Equipment 209–210

load carry harness 244
masks 27–28, **128**, 186
navigation 244–245, **245**
personal watercraft **205**, 250
underwater propulsion device **120**
Esbern Snare, HDMS 123, 125
Esper, Mark 79
Evans, Able Seaman 35
exfiltration 189, **192**
expansion 289
Expeditionary Reconnaissance and Clearance 106

Falklands War 92, **92**, 110, 186, 188, 216
Fell, Commander W.R. 32
female divers
Denmark 152–153, **153**
Irish Naval Service 154, **154**
The Philippines 160, **160**, **161**
Royal Navy 151–152, **151**, **152**
US Army 148–150, **149**, **150**, 155–157, **155**, **156**, 158–159, **158**
US Navy 148, 159
Financial Times 63
Finland 65, 75, **75**, **76**, 77
Fleet Diving Group, Royal Navy 112–114
Florence 21–22
Fosdick, Dean 279
France
2nd French Foreign Legion Parachute Regiment 122–123, **122**, 177–178
Commandos Marine 117, **118–119**, 120–121, **120**, **121**, 175–177, **176**
swimmer delivery vehicles 216–217
Fraser, Lieutenant I. 45, 46
French Foreign Legion 122–123, **122**, 177–178
frogmen 11
Frømandskorpset, Denmark 123, **124**, 125, 152, **153**, **212**
Fuerza Especial Naval, Honduras 180–181, **180**, **181**
future challenges 286–292

Garner, Seaman Nancy 'Kati' 157, **157**
Germany, Kommando Spezialkräfte Marine 125–128, **126**, **127**, **128**, 179–180, **179**, **252**
Giannotti, William 48
Gibraltar 13–14, 17–18, 20–21, **21**
Gleeson, James 291
Global Times 271–272
Great Yarmouth 43
Green Berets 80, 81, 93–96, **93**, **94**
first female 159
Special Forces Operational Detachment Alpha 93
training **170**, 171–174, **171**, **172**
Grenada 86
GRU 137
Guinea, Gulf of 123
Gulf War II 110

Hancock, Ralph 17–18
harbour clearance **144**
harbour defence 266–267
Hasler, Captain H.G. 25–26, 28–29, **30–31**
Haynes, Paul 242, 244, 247–248, 288–291
Haynes Marine Ltd 288
helicopters 50, 111, 127, **129**, **145**, 191, **191**, **192**, **193**
Hicks, Gary 202–203
Honduras, Fuerza Especial Naval 180–181, **180**, **181**
Hubei Daily 272
human torpedoes 13–14, 20–21, **21**, 32–35, **33**, 46

infiltration 111, **124**, **129**, 138, **145**, 146–147, 183–184, **200**, **201**, 289
aircraft 190, **190**
canoes 185, **185**, 188
helicopters 191, **191**, **192**, **193**
inflatable boats **186**, 188–189, **188**, **190**, **197**
parachute 192–193, **193**, **194–195**, 196–197

raiding craft 197–198, **197**, **198**
submarines 185–186, **185**, **186**, **187**, 188–189, **188**, 196
training **172**
inflatable boats, infiltration **186**, 188–189, **188**, **190**, **197**
Institute of Peace and Conflict Studies 202–203
intelligence gathering 50–51, 78–79
inter-service cooperation 127
IRA **201**
Iran 211
Iraq 85, 96, 97, 101
Iraqi Freedom, Operation 223
Irish Naval Service, female divers 154, **154**
Israel 140–141, **140**
Naval Commandos 102–103
Italian Navy, Decima Flottiglia MAS 13–14, 18–21, **21**, 22–23

Jægerkorpset, Denmark 125, **125**
Jersey 117
jetboots 249–250, **250**
JFD Carrier Seal **229**, 231–232, **231**, **232**
JFD Shadow Seal **229**, 232
JFD Sub Seal 231
JFD Torpedo Seal **229**, 232
Jimmy Carter, USS **280–281**, 283
Johnson, Sergeant Stephanie 148–150, **149**, **150**

Kaafjord 37
Kapal Selam Mini 241
Karlskrona naval base, Sweden 56, **60–61**
kayaks 11
Ker, Lieutenant Commander Catherine 151, **151**
Kerrey, Joseph R. 51–52
Knowles, Sydney 21
Knudson, Jim 249
Kommando Spezialkräfte Marine, Germany 125–128, **126**, **127**, **128**, 179–180, **179**, **252**
Korean War 47–48, **47**

La Vignole 22
Landing Craft Obstruction Clearance Unit 39, 41
Landing Craft Vehicle Personnel 98
Lene (Danish diver) 152–153, **153**
Leonhardsen, Odd 255
Liberation Tigers of Tamil Elam 203–204
limpet mines 30, **30–31**, 32, 45–46, 209–211, **209**, **210**
Lithuania **184**
Livorno 22
Loch Corrie 33
Lofoten-Vesterålen (LoVe) Ocean observatory 70–71, 73
Longyearbyen **71**, 73
Losharik (Russian submarine) 285
LR5 rescue mini-sub 239–240, **239**
Luhansk 132, 135

McCormick, Staff Sergeant Danny 180–181
Magennis, Leading Seaman 45–46
MAKO Diver Delivery System 245
Mali 101
Manta AUV 269, **269**
Marine Lizard 271–272
marine mammals programmes 258–259
benefits 262
North Korea 264
Russian 263, **263**
training 261
US Navy 259–262, **260**, **262**
Marine Specialized Technology Group 227
Maritime Counter Terrorism 85–86
Maritime Explosive Ordnance Disposal 107
Maritime Special Operations Forces, Netherlands 96–99, **99**, **100**, 101–102, **201**, 250
32nd Raiding Squadron (Dutch Caribbean Forces) 98–99
anti-piracy operations 204, **205**, 206–207, **207**
Landing Craft Utility (LCU) Troop 98
Logistic Support Group 101, 102

Maritime Counter Terrorism Squadron 101
training 101, 102
Mariupol 135
Mark 8 SDV 223
Mark 11 SDV 223–225, **224**
Marsloe, Tony 22
Miani, Lino 79
Military.com 271
mine clearance 41–43, **49**, 106, 113, 115, 208–209
beaches 213–214, **213**, **214**
limpet mines 209–211, **209**
sea mines **208**, 211–212, **212**
mine investigation exploration 113–114
mini-submarines 233–234, 240–241
Closed-Cycle Energy Source (CCES) powered craft 235
Deep-Discharge Lead-Acid Battery-powered vehicle 235
Kapal Selam Mini 241
LR5 rescue mini-sub 239–240, **239**
Piranha concept **233**, 234–235, **235**
Russia 241
S303 submersible 238
S361 swimmer/diver lock-out submersible 236–238, **236**, **237**
S401 diver lock-out mini-submarine 238–239
USSR 56–57, 59, 61–64
World War II 35–37, **36**, **37**, 45–47
x-TS1700 mini-sub 241
Moen, Tore Lasse 74
Moray AUV 269
MSubs Ltd (Marlin Submarines Ltd) 236, 238
Mukti Bahini 130
Murmansk Sea Biology Research Institute 263
Muskö incident 61
‘MythBusters’ 254

Naples 23
NATO 57, 65, 75, 227, 248–249, 289
Naval Commandos, Israel 102–103
Naval Diving Group, The Philippines 143–144, 183
Naval EOD Group, The Philippines 143, 183
Naval Special Operations Group, The Philippines 142–147, **144**, **145**, **146**, **147**
Navaltoday.com 212
navigation equipment 244–245, **245**
Netherlands, Maritime Special Operations Forces 96–99, **99**, **100**, 101–102, 164–167, **201**, 204, **205**, 206–207, **207**, 250
Netherlands Marine Corps 97, 286–287
New Zealand Special Air Service 116
North Korea, marine mammals programme 264
Norway 65, 70–71, **70**, **71**, **72**, 73–75, **73**

Ocean X Team 63–64
Odesa **131**, 135
offshore oil and gas platforms 200–202
Onyx, HMS 186, 188
Operation *Ivy Bells* 283
Operation *Struggle* 45–46
Operation *Warden* 78–79
Oquendo, Sergeant Major Roberto 80–81, 95
Ortega Submersibles 232
overheating 45

Pakistan, Special Service Group Navy 240–241
Palestine 23, 140–141, **141**
Panama 86
parachute equipment 47
parachute training 166, 170
parachuting 93, **104**, 111, 116, 138, 192–193, **193**, **194–195**, 196–197
Pelton, Ronald 283
Perch, USS 48
Perry Inc 235
personal watercraft **205**, 250
Philippines, The 141–142, 202
Combat Service Support Group 144–145
female divers 160, **160**, **161**
Naval Diving Group 143–144, 183

Naval EOD Group 143, 183
Naval Special Operations Group 142–147, **144**, **145**, **146**, **147**
Naval Special Operations Training and Doctrine Center 145
SEAL Group 142–143
Special Boat Group 143
submarines 147
Phoenix International Australia 240
piracy 123, 125, 199, 203–204, 206–207
Plackis, First Lieutenant Christie 155–157, **155**, **156**
PLUTO pipeline 278
Portsmouth 23
pot pressure chamber 24–25, **24**
Potter, John 248–249
Professional Mariner 238–239
PT Palindo Marine 241
Pucet Harbour raid 46

Queen Elizabeth 2: 199–200, 200
Queen Elizabeth, HMS 19

reconnaissance 126
Remote Operated Vehicles 265–267, **266**, 289
Royal Australian Navy 103
Royal Marine Boom Patrol Detachment 25–29, **26**, **30–31**, 32, **32**
Royal Navy 13–14
Autonomous Underwater Vehicles 268–269, **269**
clearance divers 112, **112**, **113**, 117, 164
Clearance Diving School 23
Combined Operations Pilotage Parties 38–39, **40**, 41–43, 45
dry deck shelters 217–218, 219
far east operations 45–47
female divers 151–152, **151**, **152**
Fleet Diving Group 112–114
Fleet Diving Group 3: 113–114
Fleet Diving Unit 1: 112–113, 219
Fleet Diving Unit 2: 113
Home Station Clearance Diving Team 23
human torpedoes 33–35, 46
Landing Craft Obstruction Clearance Unit 39, 41
mine clearance 211–212
mini-submarines 35–37, **36**, **37**, 45–46, 233–234
Multi-Role Ocean Surveillance ship 285
Northern Diving Group 114, 152
Royal Marine Boom Patrol Detachment 25–29, **26**, **30–31**, 32, **32**
Southern Diving Group 115
training 164
Underwater Working Party 14, 16–17, 17–18, **18**
World War II 12, 13, 14, **15**, 16–18, **16**, **17**, **18**, 21–23, 233
Royal Swedish Navy 57, 62, **62**, **63**, **65**
Rung Sat Special Zone 50
Russian Federation 135–137
cables and pipelines attacks 279–281, 284–285
deep submergence vehicle **282**
Directorate of Deep Sea Research 285
invasion of Ukraine 132, 135, 135–136
marine mammals programmes 263, **263**
mini-submarines 241
Naval Commandos 256
occupation of Crimea 132, 135
Spetsnaz 56, 64, 77, 137–140, **138**, **139**, 181–182, **182**, 279–281
submarines 284–285
Swedish incursions 63–65
weapons 255–257, **255**, **257**

S303 submersible 238
S361 swimmer/diver lock-out submersible 236–238, **236**, **237**
S401 diver lock-out mini-submarine 238–239
sabotage 126
Salimbacod, Arlene **161**
Saratov (Russian landing ship) 274–278, **275**, **277**

SAS 109
Savunma Teknolojileri Mühendislik ve Ticaret A.S. 240–241
SCUBA diving equipment 48, **75**, **131**, **168**
sea lions 259–261, **260**, 261, 262, **262**, 263, **263**
Sea Otter Marine Crawler 270
Sea Ox Marine Crawler 270
SEAL Group, The Philippines 142–143
SEALs 12, 49–53, **52**, 78, 80, 81, **82–83**, **84**, 85–86, **85**, **88–89**, 167–170
  Achille Lauro operation 200
  Black Squadron 86
  Delivery Vehicle teams 84
  'Hell week' 169
  infiltration **194–195**
  organization 81
  SEAL Team One 53
  SEAL Team Six 85–86
  SEAL Team Two 53
  Special Boat Squadron 84
  swimmer delivery vehicles 217
  training 80
Senn, Natasha 152, **152**
Sicily 39
Singapore 78
  naval diving unit 128–129, **129**, 178–179
Sleeping Beauty 32, **32**
Snake Island, Ukraine 135
Somalia 97
Sovetskya Latviai (factory ship) 279–281
Spain 18–19
Sparks, Bill 29, **30–31**
Spartan, HMS 217–218
Special Air Service 115–116, 186, 188
Special Boat Group, The Philippines 143
Special Boat Service 11, 12, 26, **27**, 45, 48, 96, 101, 109–111, **110**, **111**, 112, 202, 216
  cables and pipelines attacks 279–281
  infiltration 186, 188, 196
  Queen Elizabeth 2 operation 199–200, 200
  swimmer delivery vehicles 217
  training 163–164
special forces, role 10
Special Operations Executive 34
Special Service Group Navy, Pakistan 240–241
Spetsnaz 56, 64, 77, 137–140, **138**, **139**, 181–182, **182**
Spitsbergen Island **71**, 73
spying **282**
stealth technology **288**
STIDD Diver Propulsion Device 227–228, **228**
Submarine Products 225
submarines. *see also* individual vessels
  dry deck shelters 217–221, **218**, **219**, **220**, **221**, **222**, 223
  infiltration 185–186, **185**, **186**, **187**, 188–189, **188**, 196–197
  Multi-Mission Platform 283
submersible canoes 30, 32, **32**
Subskimmer 225–227, **226**, **227**
Suez Canal 102–103
Sutton, H.I. 250
Svalbard Undersea Cable System 73–74
Sweden
  Coastal Defence Group 54
  Coastal Rangers 55, **55**, **66**, 67–70, **68**, **69**
  Furusund mine chain 57
  Karlskrona naval base 56, **60–61**
  military budget 65
  Muskö incident 61
  Russian incursions 63–65
  Soviet incursions 54–59, **55**, **58**, **60–61**, 61–62
swimmer delivery vehicles 215–217, 288
  dry deck shelters 217–221, **218**, **219**, **220**, **221**, **222**, 223
  James Fisher Defence 229–230, **229**
  JFD Carrier Seal **230**, 231–232, **231**, **232**
  JFD Shadow Seal **230**, 232, **232**
  JFD Sub Seal 231
  JFD Torpedo Seal **230**, 232
  Mark 8: 223
  Mark 11: 223–225, **224**

STIDD Diver Propulsion Device 227–228, **228**
Subskimmer 225–227, **226**, **227**
VICTA 228–229, **228**, **229**
swimmers 11
Syria 96, **139**

Tactical Diving Vehicles 289–290
Takaeo, attack on 45–46
temperatures 45
terminology 11
Thornton, Michael E. 52–53
Tirpitz 34–35, 37
training 10, 16, **16**, 23, 28, 46, 77, 91, 101, 102, **107**, 116, **128**, **131**, **133**, 135, **184**
aptitude tests 166
Australia 174–175, **174**
basic 162
clearance divers 164
cross-training 93–94
decompression chambers **162**
Denmark **165**
drown-proofing **167**, 172
female divers 149–150, 151, 152–153, 154, 155–156, 158–159, **158**
France 175–178, **176**
Germany 179–180
Green Berets 93, 95
Honduras 180–181, **180**, **181**
human torpedoes 32–33
infiltration **172**
marine mammals 261
Netherlands 164–167
parachute 166, 170
The Philippines 183
Royal Navy 164
SCUBA **168**
SEALs 80, 167–170, **167**, **168**, **169**
Singapore 178–179
Special Boat Service 163–164
Spetsnaz 137, 138, 181–182, **182**
US Army **170**, 171–174, **171**, **172**
US Marine Corps 170
US Navy 167–170, **167**, **168**, **169**
Tula Instrument Design Bureau 256
Tuna, HMS 28
Tunney, USS 48

U-137 (Soviet submarine) 58–59, **58**
Ukraine 75, 263
73rd Naval Special Purpose Center 135
emergency rescue special forces **134**
Russian invasion of 132, 135, 135–136
Saratov sinking 274–278, **275**, **277**
Snake Island 135
Special Operations Forces combat divers 130, **131**, 132, **133–134**, 135
underwater acoustic network 248–249
Underwater Damage Repair 107
underwater force protection 113–114
underwater visibility **176**, 207
United Kingdom Special Forces (UKSF) group 109
United States of America 79–81
Naval Special Warfare Groups 81
Space Force 95–96
US Army
female divers 148–150, **149**, **150**, 155–157, **155**, **156**, 158–159, **158**
Green Berets 80, 81, 93–96, **93**, **94**, 159, **170**, 171–174, **171**, **172**
training **170**, 171–174, **171**, **172**
US Marine Corps 81, 86, 87, **90**, 91–92, **94**, 99, 170, **250**, **270**, 271, 272
US Navy 81, 211
Boat Support Units 50
cables and pipelines attacks 282–283
Combat Demolition Units 44
Dry Combat Submersible 225
dry deck shelters 217, 218–219, **218**, 223
female divers 148, 157, **157**, 159
marine mammals programmes 259–262, **260**, **262**
Mobile Support Teams 50

Naval Special Warfare Groups 81
Ordnance Disposal Team **49**
raiding craft **198**
Reconnaissance and Interdiction Division 261–262
SEALs 49–53, **52**, 77, 80, 81, **82–83**, **84**, 85–86, **85**, **88–89**, 167–170, **167**, **168**, **169**, **194–195**, 200, 217
Special Warfare Group–Vietnam. **50**
submarines **85**, **280–281**, 283
Underwater Demolition Teams 47–49, **47**, 81
US Navy Institute News 264
USSR 97
Baltic Fleet 57
cables and pipelines attacks 282–283
Dolphin unit 136–137
marine mammals programmes 263
mini-submarines 56–57, 59, 61–64, 234
Norwegian incursions 73–75
Spetsnaz 138
submarines 58–59, **58**, 139, **139**
Swedish incursions 54–59, **55**, **58**, **60–61**, 61–62

Valiant, HMS 19
van Willigenburg, Major Axel 287
Venice 22
Ventiorini, Sub Lieutenant 22
Vickers Piranha concept **233**, 234–235, **235**
VICTA 228–229, **228**, **229**
Vietnam War 48–53, **49**, **50**, **51**, **52**
Visintini, Licio 13–14

Waldron, T.J. 291
Walter, Sergeant Angela 95
weapons **94**, 244
ammunition 251, 252, 255, 256
assault rifles **138**
Colt Canada C8A2 carbine 253
Heckler & Koch G36K 252
Heckler & Koch HK P11: 257
Heckler & Koch HK416: 253
Heckler & Koch MR 762: 253
over the breach 253
pistols 69, 256–257, **257**
protection 251–252
rifles **68**, 69, 252–256, **252**, 257
Russian Federation 255–257, **255**, **257**
sub-machine guns **27**
underwater 126, 251–257, **252**, **255**, **257**
wind 249
Wolk, Eugenio 22–23
Wonsan Harbour landing 48
World War II 10, 11, 13–23, 271, 291
Admiralty Experimental Diving Unit 24–25, **24**
Bordeaux raid 28–29, **30–31**
D-Day 38–39, **40**, 41–43, 44
far east operations 44–47
human torpedoes 32–35, **33**
mini-submarines 35–37, **36**, **37**, 45–46, 233
PLUTO pipeline 278
Royal Marine Boom Patrol Detachment 25–29, **26**, **30–31**, 32, **32**
Tirpitz midget submarine raid 37
Wright, Commander Bruce 27–28
Wuchang Shipbuilding Industry Group 272

X-Craft 35–37, **36**, **37**
x-TS1700 mini-sub 241

Yantar (research vessel) **282**, 285
Yegorov, Oleg 136–137